ILLINOIS BIRDS:

Picidae

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Fig. 1.—Yellow-shafted flicker at a suet feeder in Urbana, Illinois. Black moustache marks indicate the bird is a male.

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THIS IS THE SIXTH in a series of papers designed to summarize the extensive literature on Illinois birds, with special emphasis on population biology. The papers also include a large amount of previously unpublished data from the authors' continuing field work, started in September 1956, plus data contributed from numerous other observers over the years, including field notes—some dating back into the last century—from Benjamin T. Gault, Alfred O. Gross, John J. Schafer, and Frank Smith and his students.

The introductions to the other papers in the series, beginning with the Mimidae (Graber et al. 1970), contain statements of our procedures and policies to which the reader of this paper should refer.

The present paper deals with the woodpeckers, of which seven species occur regularly in Illinois in substantial numbers, one (the three-toed) occurs only irregularly, one (Lewis') is of accidental occurrence, and one (the ivory-bill) is extirpated and possibly extinct. References to a "white-headed woodpecker" (Musselman 1916 and 1916–1917) we assume refer *not* to the western species of that name (*Dendrocopos albolarvatus*), but to an aberrantly plumaged bird of some other species.

As we have examined the available information on the woodpeckers and other species in recent years and have observed, concommitantly, the accelerating deterioration of natural habitats in Illinois, the need for more precise knowledge of population-habitat relationships has become increasingly apparent. The ample acreages of diverse habitats that supported about 400 species of Illinois birds into the twentieth century are now being obliterated at an alarming rate. The survival of even remnant populations of many of these species will depend upon first understanding both the qualitative and quantitative characteristics of the habitat for each species and then preserving suitable habitat areas of sufficient size wherever possible.

To help with the understanding of habitat-bird population relationships, in June 1973 we inaugurated annual studies of breeding and winter populations of birds on several selected forest areas in southern Illinois where we also studied the plant populations. These studies of eight mature bottomland forests and five upland forests have revealed some interesting correlations between woodpecker population densities and vegetational composition and structure, which are discussed under each species account. To insure adequate census samples, we chose to study extensive forest tracts—each 300 acres or more in extent. No sizeable natural community is strictly homogeneous, and each of our study areas includes a number of vegetational associations—old stands of several species of trees intermingled in places with younger thickets where old trees have fallen, opening the canopy to sunlight for new growth. Considering the inherent variability of each community and other variables, such as weather, annual change, and observer alertness that affect the populations and/or the census, it is perhaps remarkable that statistically significant correlations between bird populations and vegetation characteristics were detected. Although all study areas had certain characteristics in common, each was also unique, providing us with a spectrum of forest types with which to compare bird populations.

We arbitrarily divided bottomland from upland forest on the basis of topography, including flatland forest of the floodplain and the first level above as bottomland and all else as upland. Certain consistent vegetational changes also marked the two types. The vegetation studies, made primarily in late summer and fall, 1974–1975, were censuses of plants in two types of circular quadrats—(1) 1/20th-acre quadrats in which all woody stems were identified and counted and their diameters (DBH) were measured and in which herbaceous ground cover was estimated as to percentage of ground covered and (2) 1/10th-acre quadrats in which only stems 4 inches or larger were counted and measured. The two types of plant quadrats were censused alternately at regular intervals of 550 feet within our census transect for birds, making the coverage about one vegetation quadrat per acre of forest censused for birds.

These parameters were examined for correlations between numbers of woodpeckers of each species and the woody vegetation: (1) Importance (Y) of each genus and species of woody plant. Importance is calculated from relative frequency, relative density, and relative basal area (Lindsey et al. 1958), and each of these factors was also examined separately for correlations with the bird populations. (2) Size of woody vegetation. Trees, living and dead, were classified as small (4–10 inches DBH), medium (10–22 inches DBH), or large (over 22 inches DBH). DBH (diameter breast high) was measured in inches at approximately 4.5 feet above the ground level. Woody plants of the understory were divided into three size classes (less than 1 inch, 1–2 inches, and 2–4 inches DBH).

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(3) Total basal area (BA) and the ratio of the BA of each size category of woody plants to the total BA of all woody plants. Scientific names of most plants can be found in Table 14. Names of plants not found in Table 14 are given as they occur in the text.

The bottomland forest areas we censused (with the letter designations used in Fig. 13, 22, and 36) were: A—Beall Woods (Wabash County); B—Jim's Pond, 2 miles southwest of New Memphis Station (St. Clair County); C—Horseshoe Lake Nature Preserve (Alexander County); D—Union County Wildlife Refuge; E—Campbell Lake, 2 miles south-southeast of Old Duquoin (Jackson County); F—Saline (Middlefork) River, 2 miles north-northwest of Dorris Heights (Saline County); G—Heron Pond Nature Preserve (Johnson County); and H—Snider (Snyder) Lake, 3 miles east of Elkville (Jackson County). The upland forest areas we censured were the upland parts of Beall Woods and Heron Pond Nature Preserves; Pine Hills, 3 miles N of Wolf Lake (Union County); Possom Trot Trail, 2 miles SW of Elco (Alexander County); and Kaskaskia Experimental Forest, 3 miles SSW of Karbers Ridge (Hardin County).

Though still too meager, there are relatively more population figures for the Picidae than for most groups, and certain points should be made here concerning the tables that summarize these data. For the sake of completeness we have included virtually all published measurements of Illinois woodpecker populations. However, it is obvious that census data for small tracts—especially areas under 30 acres—may be badly distorted because of the relatively large amount of edge and the reduced possibility that the less common species of a fauna may be represented (Graber & Graber 1976). The reader should, therefore, use discretion in accepting the population figures presented for small areas. Also, because in most cases some interpretation is required in abstracting population figures from publications, we recommend that the reader refer to the original sources if possible. In the population tables where we have referred to the range of densities in a long series of censuses, most notably those of S. C. Kendeigh and his students, we have cited only the papers that show the extremes of the population range. Space limitations make it impossible to list all of the papers in the series. The range of population densities given for our recent (1973–1976) strip censuses is not the range for annual variation, but the range for different forest tracts, in each of which we censused at least 40 acres.

These journals were sources of Christmas-count data: *Bird-Lore* 1901–1940, *Audubon Magazine* 1941–1946, *Audubon Field Notes* 1947–1970, *American Birds* 1971–1976, and *Audubon Bulletin* 1932–1975. Since the counts are made in late December and early January of the following year, the year given in figures and tables refers to the year represented by January.

We have included scientific names, excepting nomenclature from other papers cited, and bird names in general, for which we follow American Ornithologists' Union checklist (1957) and supplements prior to 1976.

As always, we are indebted to a number of people for help, particularly for contributions of data and opportunities to examine bird specimens and use data from several scientific collections. We would particularly like to mention Frank Bellrose and Robert Crompton of the Illinois Natural History Survey; S. Charles Kendeigh of the University of Illinois; Marilyn Campbell, Gary L. Wilford, and Robert J. Schifo of the Vermilion County Conservation District (Forest Glen); Charles T. Clark of Des Plaines; Maurice Reed and Jack Keegan of Dixon; Bowie Hannah of Dix; William S. Brenneman of the Illinois Power Company; H. David Bohlen and Tim Cashatt of the Illinois State Museum; Vernon Kleen of the Illinois Department of Conservation; William B. Ahern and Merril McHenry of Greenville College; John Wanamaker of Principia College; L. Barrie Hunt of Eastern Illinois University; Donald F. Hoffmeister of the University of Illinois Museum of Natural History; Dale Birkenholz and Carol Forsyth of Illinois State University; Melvin Traylor and Emmett Blake of Field Museum; William Beecher of the Chicago Academy of Sciences; and Harlan D. Walley and William Southern of Northern Illinois University. Wallace LaBerge of the Illinois Natural History Survey, Section of Faunistic Surveys and Insect Identification, identified insects for us. We also benefited greatly in the preparation of the manuscript, photographs, and figures from the work of Eleanore Wilson and Elizabeth McConaha of the Survey's Wildlife Research Section and Larry Farlow and Lloyd LeMere, Survey Technical Photographer and Technical Illustrator, respectively. Glen C. Sanderson provided a thorough editing of the first draft of the paper, and Robert M. Zewadski edited the manuscript for publication.

YELLOW-SHAFTED FLICKER
(Colaptes auratus)

(Fig. 1 and 2)

Yellow-shafted flicker remains the most precise name for the flickers of Illinois (excepting red- or reddish-shafted birds) despite the recent recommendation that the common name for the flicker complex be "common flicker" (Eisenmann 1973). Either name is appropriate.

Spring Migration

Flickers have been recorded in all regions of Illinois at all seasons of the year, but there are well defined spring and fall migrations throughout th

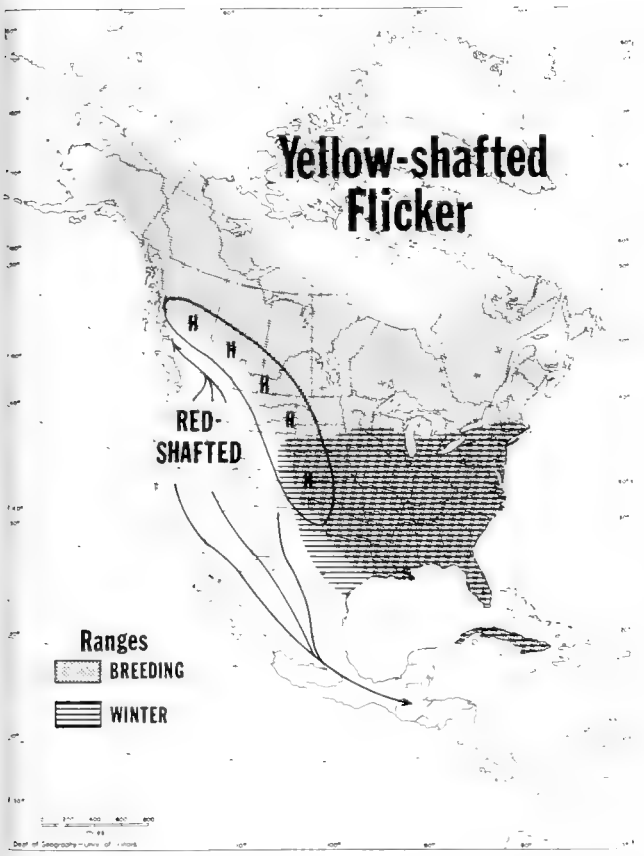

Fig. 2.—General distribution of the common flicker. The range shown here may include large sections in which populations of the species are thin or even absent because of the nature of the terrain and lack of suitable habitat. The outlined area labelled with H's is roughly the zone of hybridization between red- and yellow-shafted birds. The lines and arrows indicate the approximate range limits for red-shafted birds.

state (Fig. 3). Flickers regularly migrate in the daytime and at night, but whether the same populations migrate both day and night is not known. The diurnal migrations are sometimes spectacular, particularly along major rivers and the Lake Michigan shore, with hundreds of birds passing a given point, singly and in flocks, in a few hours (Widmann 1907; Nolan 1958; Fawks 1967). Diurnal flights have been reported much less often in spring than in fall, suggesting that the routes differ in spring and fall. Except on the Lake Michigan shore, the number of flickers seen migrating is usually much lower in spring than in fall. However, Robert Crompton and Frank Bellrose (personal communications) have recorded diurnal migrations of flickers every spring on or near the Illinois River, where at least a few migrating birds were seen almost every day that observations were made in March and April. Topographic land features, such as large rivers, apparently concentrate the migrants, for we see the diurnal migrations away from such features but rarely and then usually at very low flight densities of only a few birds per hour. The flights, both on and off the rivers, are usually detected at relatively low altitudes—50 to 300 feet above local terrain. The flight directions are generally northward in spring, often over or paralleling a river, the headings varying in different places from northwest to directly east. On Lake Michigan the headings may be northward, paralleling the shore, or eastward around the southern tip of the lake (Nolan 1958). Diurnal flights have been seen at all hours of the day, but most commonly between 5:00 and 11:00 a.m. CST.

The night migration of flickers seems to differ in more than timing from the diurnal migration. The night flights are probably not concentrated at topographic features but move on broad fronts, as is typical of long-distance night migrants in general. We have heard flickers apparently migrating at night during April and May in central Illinois, but much more commonly in fall than in spring. We have heard them at virtually all hours of the night, from shortly after the onset of darkness (7:00 p.m. CST) to nearly dawn (4:55 a.m. CST). Strangely, the timing of calling differs in spring and in fall. In spring most of the calling comes after midnight; in fall it is more evenly distributed though with more before than after midnight. It is possible that diurnal migrations are merely extensions of the night flights, made conspicuous as birds aggregate along landscape features, but no observations support this view as yet. A large kill of flickers occurred about 10:00 p.m. on the night of 16 April 1960, when strong winds forced flickers and many other night migrants into the waters of southern Lake Michigan (Segal 1960).

In some years in southern and central Illinois, and more rarely in the north, increases occur in the flicker population in February (Lyon 1921*b*; DuMont 1947*b*), perhaps indicating the start of the spring migration. Much more commonly the onset of the migration throughout the state is noted during March (Fig. 3; Cooke 1885*a* and 1888; Musselman 1913), varying year to year from early to late March (Widmann 1907). The early part of the migration often coincides with robin migrations (Cooke & Widmann 1884). Peak numbers occur from mid-March to mid-April in southern Illinois and from late March to late April in central and northern Illinois (Fig. 3). At Chicago Beal (1886) recorded on 17 April a great wave of flickers, which had departed by the 23rd. Migrant flickers are often seen at this season foraging in pastures in flocks of a dozen or more birds.

Distribution

The complex of flickers, including both yellow-shafted and red-shafted, occurs throughout much of North America and Mexico and south to Nicaragua. In winter the range of the yellow-shafted flicker contracts mainly into the eastern and central United States (Fig. 2).

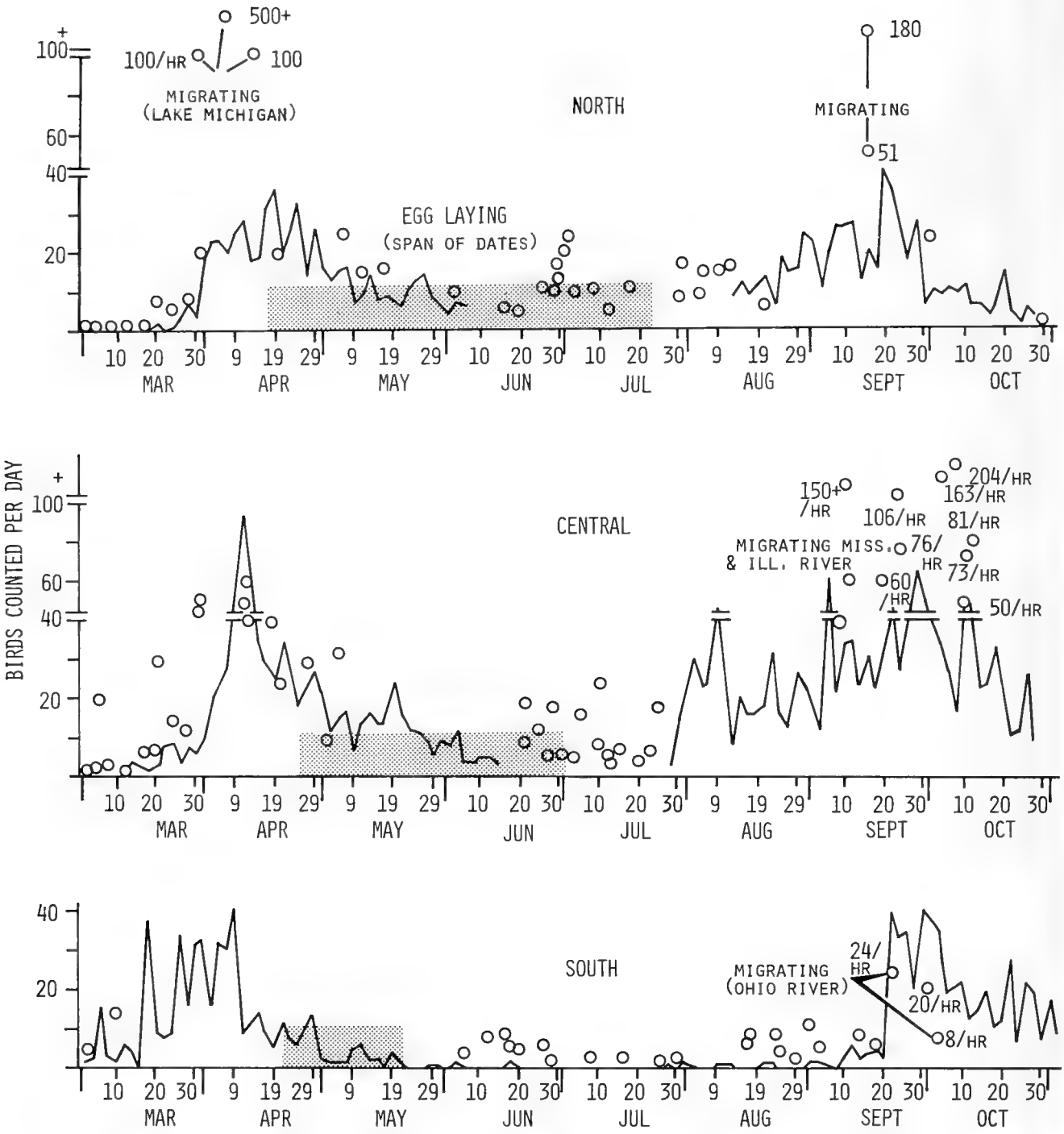

Fig. 3.—Egg-laying and migration seasons of the yellow-shafted flicker in different regions of Illinois (see Fig. 5 for regions). Spring and fall graph lines show the higher daily count of each 4 days (1967–1970). Hollow circles represent counts made in other years or by other observers. Shaded areas show the span of dates during which egg laying has been recorded.

Yellow-shafted flickers almost certainly nest in every county in the state, but their true distribution is still unknown (Fig. 4).

Nesting Habitats and Populations

The 1957–1958 state censuses showed the flicker to be the most common woodpecker in Illinois, and this ranking in population probably has not changed. As a cavity-nesting species like other woodpeckers, the flicker requires at least medium-sized trees for nest sites. However, the flicker is less a forest species than any other Illinois woodpecker though the red-head shows similar habitat preferences. Both species show affinities for more open habitats and edge situations

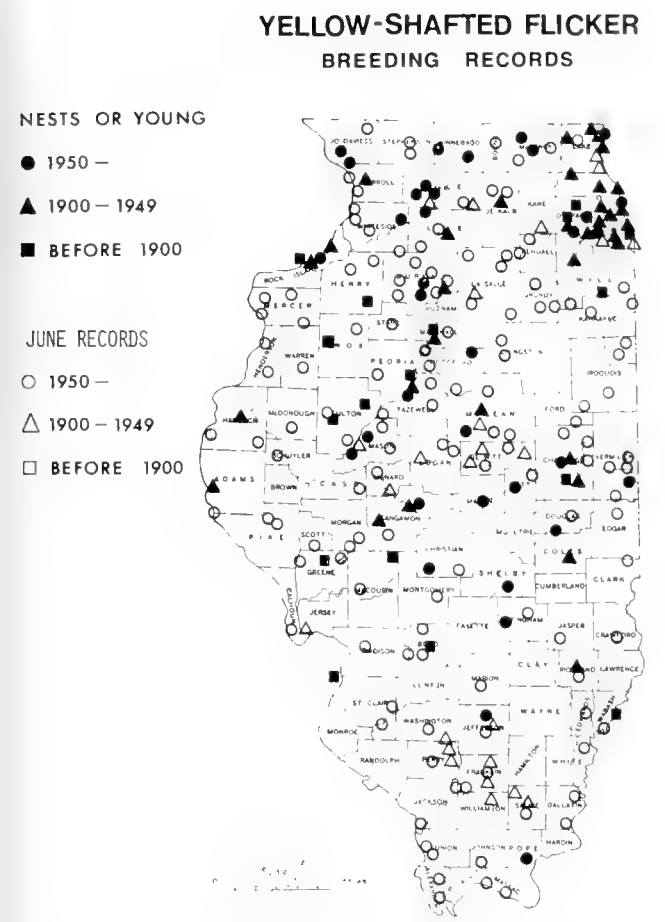

Fig. 4.—Breeding records of the yellow-shafted flicker in Illinois. Hollow symbols represent birds seen or heard in June.

In forest areas flickers tend to avoid the interior and occupy the forest edge (Hankinson 1915; Kendeigh 1941). The most striking difference in summer habitat between the flicker and the red-headed woodpecker is the flicker's greater use of urban residential habitat (Tables 1 and 10).

Grass foraging areas are important to the flicker (Swink 1959), and pastures have been a significant habitat for the species (Table 1).

The comparative censuses of 1907–1909 and 1957–1958 showed that both the flicker and red-head underwent drastic population reductions—on the order of 90 percent in about 50 years in Illinois. The change was caused by something besides the loss of habitat, because the densities of populations declined in nearly all habitats (Table 1). A loss of habitat acreage would not necessarily change population densities. As late as the 1930's observers in northern Illinois believed the flicker population was increasing (Eifrig 1930*a* and 1938; Blocher 1934). In 1933 in a four-block area of Congress Park, Illinois, Bodensten (1934) counted 22 flicker nests—a very high density not even approached in recent decades. The decline after 1930 coincides strikingly with the establishment of the starling population in the state. The starling was still rare in Illinois in 1928 (Eifrig 1930*b*), but its population grew rapidly in the 1930's, competing increasingly with the native cavity nesters. In urban residential habitat, where flickers and starlings are perhaps most competitive, flicker and starling populations are inversely correlated (Graber & Graber 1963).

The reduction in densities of flicker populations could also have resulted to some extent from a deterioration of habitat quality, e.g., the loss of nest trees from pastures, but there have been no quantitative studies to demonstrate such changes. Besides the decline in population densities, some of the overall population decline can be attributed to the loss of acreage of some favorite nesting habitats, such as hedge rows, savannahs, orchards, and pastureland.

Since the time of the first statewide censuses (1907), flicker populations have apparently always been highest in the northern region of the state, lowest in the south (Table 1). This difference is not merely a matter of habitat availability, as population densities have been consistently higher in the north regardless of habitat. Why habitats in the north support more flickers than the same habitats in the south is a question that warrants investigation. The flicker's population decline, although statewide, was particularly severe in the south for reasons not clear. Our subjective impression is that the flicker population has been increasing in recent years, particularly in the south.

Nest sites of flickers mentioned in the Illinois literature are listed in Table 2. Nests are often located in dead trees and in softwood species, such as poplars, usually in the trunks. Burns (1900) felt that flickers rarely excavated completely sound (healthy) trees. Many observers noted that nest trees were large or old (Strode 1888; Silloway 1906; Schafer 1933; Work 1933). As the nest chamber may be 6–7 inches in diameter (Ford 1939), at least one fair-sized tree is required in such open nesting habitat as pasture. The essential requirements for flicker habitat have never been determined.

Published data on 46 flicker nests, mainly in northern and central Illinois, showed the height to vary from 4 to 45 feet (average: 16 feet), with no obvious preferred height.

Data on flicker territory size are scant. One territory measured by Calef (1953*a* and 1953*b*) in McLean County was 1.55 acres, a small area by comparison with territories of the red-bellied woodpecker (Calef 1953*a*). A study of territory size in more open savannah habitat versus forest-edge would be particularly interesting.

Nesting Cycle

The homing of flickers to the same nesting territory—even to the same nest cavity between years—has

TABLE 1.—Breeding populations of yellow-shafted flickers in various Illinois habitats.

Habitat	Acres	Birds per 100 Acres[a]	Years	Type of Census	Region or County	Reference
Suburban residential	8	50	1916	Nest	Richland (S)[b]	Cooke 1916
Urban residential	160	6	1958	Strip	North	Graber & Graber 1963
Urban residential	75	8	1958	Strip	Central	Graber & Graber 1963
Urban residential	98	4	1958	Strip	South	Graber & Graber 1963
Modified woodland (human housing)	28	29	1937	Nest	Lake (N)	Beecher 1942
Unmodified woodland	27	22	1937	Nest	Lake (N)	Beecher 1942
Oak-maple forest	55	0–7 (avg 3.2)	1927–1943	Map	Champaign (C)	Kendeigh 1944
Oak-maple forest edge	1.25 miles[c]	0–8[c] (avg 3.1)	1944–1957	Map	Champaign (C)	Kendeigh 1948*b*; Kendeigh & Gillespie 1955
Oak-maple forest edge	1.25 miles[c]	8–22[c] (avg 14.0)	1958–1974	Map	Champaign (C)	Kendeigh 1960*b*; Kendeigh & Brooks 1964*b*
Oak-maple forest	64	3	1943	Map	Champaign (C)	Johnston 1947
Forest (all types, including edge)	177	5–6 (avg 5.6)	1957–1958	Strip	North	Graber & Graber 1963
Forest (all types, including edge)	214	2–3 (avg 2.3)	1957–1958	Strip	Central	Graber & Graber 1963
Forest (all types, including edge)	60	5–13 (avg 10.0)	1907, 1909	Strip	South	Graber & Graber 1963
Forest (all types, including edge)	340	0	1957–1958	Strip	South	Graber & Graber 1963
Virgin floodplain forest	77	4	1948	Map	Sangamon (C)	Snyder et al. 1948
Mature bottomland forest	63	3–6 (avg 4.8)	1950–1951	Map	McLean (C)	Calef 1953*a*
Mature bottomland forest	1,077	0–7 (avg 0.7)	1973–1975	Strip	South	This paper
Grazed bottomland woods	53	7	1955	Map	Macon (C)	Chaniot & Kirby 1955*b*
Mature upland forest	479	0–2 (avg 0.4)	1974–1975	Strip	South	This paper
Upland second-growth forest	56	4–11 (avg 7.3)	1941–1944	Map	Sangamon (C)	Robertson 1941*b*, 1942*b*, 1944*b*
Upland oak-hickory	24	13	1967	Map	Hancock (C)	Franks & Martin 1967
Second-growth hardwoods	15	27–40 (avg 33.3)	1937–1938	Map	Rock Island (N)	Fawks 1937, 1938
Woods (unspecified)	20	0–10 (avg 3.3)	1914–1916	Nest	Rock Island (N)	J. J. Schafer (unpublished notes 1914–1923)
Woods (unspecified)	54	0–9 (avg 6.0)	1917–1923	Nest	Rock Island (N)	J. J. Schafer (unpublished notes 1914–1923)
Orchard	45	4–21 (avg 11.1)	1907, 1909	Strip	South	Graber & Graber 1963
Orchard	78	0	1957–1958	Strip	South	Graber & Graber 1963
Late shrub	21	32	1966	Map	Vermilion (C)	Karr 1968
Shrub area	32	0–6 (avg 3.1)	1957–1958	Strip	North	Graber & Graber 1963
Shrub area	181	0	1957–1958	Strip	Central & South	Graber & Graber 1963
Swampy prairie	64–67	3–9 (avg 6.1)	1941–1944	Map	Sangamon (C)	Robertson 1941*a*, 1942*a*, 1944*a*
Pasture	193	17	1909	Strip	North	Graber & Graber 1963
Pasture	279	3	1957–1958	Strip	North	Graber & Graber 1963
Pasture	442	8–15 (avg 10.4)	1907, 1909	Strip	Central	Graber & Graber 1963
Pasture	172	0–2 (avg 1.2)	1957–1958	Strip	Central	Graber & Graber 1963
Pasture	882	3–4 (avg 3.3)	1907, 1909	Strip	South	Graber & Graber 1963
Pasture	120	0	1957–1958	Strip	South	Graber & Graber 1963

[a] All figures were converted to birds per 100 acres (territorial males or nests × 2).
[b] S refers to the southern region of Illinois, C to the central, and N to the northern region, as shown on winter distribution maps, e.g., Fig. 5.
[c] These entries are miles of forest edge and birds per mile of edge.

been demonstrated from banded birds in northern Illinois (Lyon 1921*a*; Smith 1925; Lincoln 1927).

The familiar "wick-er–wick-er" call may be heard in any month of the year in Illinois, but calling increases in February and March through May. Courtship and territorial displays, often seen through March and April (Musselman 1934–1935; Craigmile 1945), are interesting and fairly complicated in pattern (Egan 1923). Particularly in April we have seen heated territorial fights between two flickers, strug-

TABLE 2.—Nest sites of yellow-shafted flickers in Illinois.

Site		Number of Nests
Apple tree[a]		15
Dead stub (unidentified tree)		13
Oaks (bur, white, blackjack, red, & unspecified)	9	11
Oak (dead)	2	
Elm (unspecified)	1	8
Elm (dead)	7	
Poplar (unspecified)	4	7
Cottonwood (dead)	3	
Willows (black and unspecified)		6
Bird houses		6
Maples (silver and unspecified)		3
Ash (unspecified)		2
Catalpa (unspecified)		1
Pine (dead)		1
Shagbark hickory		1
Walnut		1
Hackberry		1
Locust (unspecified)		1
Building		1
Telephone pole, fencepost		2
Total		*81*

[a] Scientific names are not given, as scientific names were not provided in the original sources.

gling on the ground often in open grass areas. In April and May pairs of flickers are also often seen mating. Ridgway (1923) noted that in southern Illinois flickers were paired by 7 March. There is little in the Illinois literature about "drumming" behavior by flickers, either of a descriptive nature or on its timing or function (Craigmile 1945).

The same nest tree and even the same cavity may be used year after year by flickers (Silloway 1906; Schantz 1934–1935) and sometimes by the same bird(s) (Lyon 1921*a*). Schantz (1934–1935) observed flickers nesting in a dead cottonwood at Berwyn every year from 1931 to 1933, each year excavating a new hole. We have observed the excavation of cavities in different parts of the state, particularly in April and May. Eifrig (1930*b*) noted that cavity excavation took 3–4 days at one nest, but other observers give the time requirement as a week to 20 days or more (Burns 1900). Cavities of 11 (mainly northern) Illinois nests varied from 8 to 24 inches in depth (average 15.5 inches). One tree cavity used by flickers was 6 inches in diameter. Ford (1939) recommended dimensions of nest boxes for flickers as (in inches): floor, 7×7; depth, 16–18; entrance above floor, 14–16; and entrance hole, $2\frac{1}{2}$ inches in diameter, the box to be placed 6–20 feet high.

No nest structure other than the cavity is made, the eggs being laid on the wood chips and dust on the floor of the cavity.

The eggs, typical of woodpeckers in general, are immaculate white. Data on 49 clutches from old (1879–1915) museum records and literature, mainly from northern and central Illinois, had this distribution: 5 eggs, 4 sets; 6 eggs, 13; 7 eggs, 9; 8 eggs, 10; 9 eggs, 8; 10 eggs, 4; 12 eggs, 1. Average clutch size for the 49 sets was 7.45 eggs. As the early oologists tended to save and publish on large sets particularly, the above distribution may be distorted. There are no recent data on clutch size for the flicker.

The flicker is renowned as an indeterminant layer, and in northern Illinois Abbott (1897) induced (by removing eggs as they were laid) a laying of 24 eggs at one nest and Bodensten (1932) a laying of 33 eggs at another. Goelitz's (1915) record of a 12-egg set was possibly a natural clutch.

The only published data on the time requirements of a nesting cycle for the flicker in Illinois are those of Holcombe (1931) and Eifrig (1931). Holcombe observed a nest in Zion that required 43 days from the laying of the first egg (of nine) to the fledging of the young. Assuming incubation began with the last egg, the incubation and nestling periods together would have been 35 days. At another nest Holcombe's data indicated an incubation period of about 12 days, leaving about 23 days as the period of nestling life.

There are no data on nesting success for any Illinois population of flickers, nor is it known whether more than one brood is attempted.

Many references have appeared in the Illinois literature on the subject of flickers and interspecific competition for nest cavities. The general tone of the comments has been that though flickers have been well able to compete with house sparrows (Bartel 1931), they have lost cavities to starlings (Holcombe 1931 and 1938; Donovan 1934; Blocher 1936*b*; Smith & DuMont 1945*a*). Despite the starling's domination, flickers may often raise broods after starlings have nested (Schafer 1933; Moseley 1947). Bodensten (1935) observed contemporaneous successful nests of starlings and flickers in the same tree only 2 feet apart. Flickers may also compete for or share cavities with squirrels and screech owls (Strode 1888; Lyon 1930; Ford 1933; Work 1933; Hammond 1934–1935), but the effects of these relationships on any population are unknown. Use of the cavities by different species is often staggered in time (Ford 1933). Reller (1972) observed instances of the use of the same nest tree (different cavities) by flickers and red-heads in one case and flickers and red-bellies in another. In both cases the nestings continued relatively harmoniously though the flickers were subordinate to both other species during occasional instances of strife.

An interesting study of animal behavior was Lyon's (1922) observations at a cavity used alternately by squirrels, screech owls, and flickers, and finally by a screech owl and flicker together. The owl apparently brooded and perhaps even attempted to feed a brood of young flickers, while the parent flickers continued to feed their young even as the owl sat. This bizarre relationship lasted at least 5 days until the flickers

fledged. The two species are not always so harmonious; a study by Brown & Bellrose (1943) showed that flickers constituted 5 of 259 prey items of screech owls in southern and central Illinois.

Fall Migration

In early August flickers generally appear to be in worn, dirty plumage, but by the end of August some seem to be in largely fresh plumage. Whether this change reflects molt in the local population or an influx of other populations, we do not know.

Frank Bellrose and Robert Crompton, Illinois Natural History Survey, (personal communication) have witnessed diurnal flights of flickers along the Illinois River as early as 31 July in 1966 and regularly through August each year, but at generally low flight densities—usually under 20 birds per hour. The flights increase in number and density, particularly after the first of September, to densities of 50 or more per hour on some days (Fig. 3). These flights are similar to the diurnal flights in spring, though on a reverse heading and generally downstream—southwest to west-southwest along the Illinois River in Mason County and south along the Mississippi River in Adams County. The birds fly singly and in flocks "Indian file," each group using about the same route on a narrow corridor and flying from tree-top level to altitudes of 500 feet or more. Such diurnal flights have been seen most often in the morning. The number of flights and the flight densities decline greatly after mid-October in central Illinois (Fig. 3), but flights have been seen as late as 21 November. In northern Illinois on the Mississippi River the migration appears to fall off much earlier—at the end of September (Fig. 3)—but the observed difference may merely be annual variation. In southern Illinois we have never detected the diurnal flights on the Mississippi, and on the Ohio River the flight densities have always been low by comparison with densities on rivers in central and northern Illinois (Fig. 3). An important but unanswered question is whether flight densities are different from one side of a river to the other. Thus far, our observations on the Ohio River have been restricted to the Illinois side. Diurnal migrations of flickers have not been reported on the Rock and Wabash rivers but should be looked for on these and other major streams.

At least one large diurnal fall flight of flickers has been recorded on the Chicago lake front (Boulton & Pitelka 1938). The diurnal migrations are not restricted to waterways but have rarely been reported elsewhere. Benjamin Gault (unpublished notes 1912) counted 51 migrating flickers in 5 minutes on 19 September at Glen Ellyn, and we have seen light migrations (three birds per hour) in November in Pope County away from the Ohio River.

In the same period that diurnal migrations of flickers are most evident, there are regular nocturnal migrations of the species. We have heard flickers apparently migrating over central Illinois on many nights between late August and the first week in October. These flights were not obviously associated with waterways or other landscape features, but were audible at various stations across the state at all hours of the night.

Flickers are relatively uncommon victims in the kills at television towers in central Illinois. We have records of only eight flickers among approximately 12,000 birds of all species picked up and identified from the towers. The flickers were killed between 27 September and 7 October, a relatively small part of the fall migration period when the migrant flicker population is at its maximum (Fig. 3). These data differ somewhat from those in Graber (1968), reflecting a great increase in the amount of field data since that paper was submitted. The low kill of flickers is puzzling in view of the number of flickers seen in the fall. The data seem to imply that most of the migration is diurnal. Are different populations in-

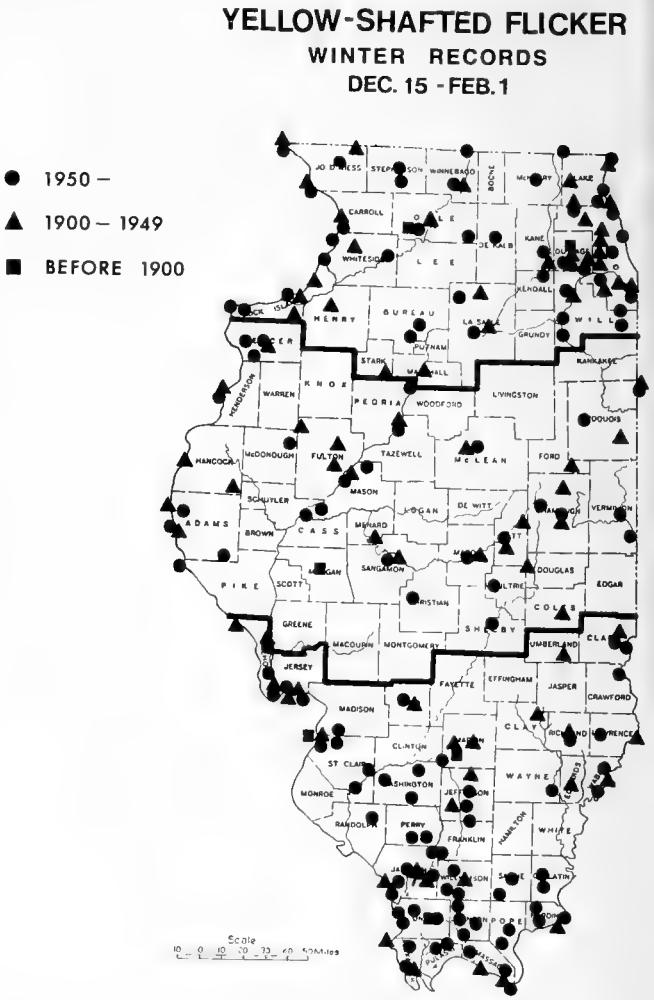

Fig. 5.—Winter records of the yellow-shafted flicker in Illinois. Heavy horizontal lines separate the three regions (north, central, and south) referred to in the text.

volved in diurnal versus nocturnal migration in this species?

Lyon's (1925) record of a flicker banded at Waukegan in June 1918 and recovered at Monroe, Louisiana, in July 1925 seems to place an Illinois breeding bird deep in the winter range at a very early date. Probably more representative of the actual migration movement for the species is a flicker banded at Zion in June 1930 and recovered at Hamilton, Alabama, 9 October 1930 (Cooke 1937). Seven published records of flickers banded mainly in summer in northern Illinois and recovered mainly in winter are remarkably consistent in location at two areas—northeastern Louisiana and northwestern Alabama (Lyon 1925; Anonymous 1931; Cooke 1937 and 1946; Lincoln 1939; Labahn 1941).

Our counts for southern Illinois (Fig. 3) show an abrupt increase in the flicker population after 20 September, probably representing large influxes of more northern populations, which stand out because of the relatively low breeding population in the south.

The ratio of our spring-to-fall counts of foraging flickers, i.e., excluding birds in actual migration flights, does not indicate high productivtiy. In northern Illinois, we saw 1.0 flicker in spring (March–May, inclusive) to 1.1 in fall (August–October, inclusive), whereas the ratio in the central region was 1.0 to 1.5 and in the south 1.0 to 2.2. East-central Illinois had higher fall populations than had west-central Illinois (1.6 to 1.0) though the spring populations were nearly the same.

Winter Populations

Yellow-shafted flickers may be found in virtually all parts of the state in winter (Fig. 5), and the number of flickers statewide may be nearly as great as the summer population. However, in winter most (70–80 percent) of the state's flicker population is concentrated in southern Illinois. Most of the rest of it is in central Illinois with relatively little of it in the northern region (Graber & Graber 1963).

This distribution is also indicated in the Christmas counts (Fig. 6); the average number of flickers per party hour (1945–1975) is nearly six times as great in the south as in the north and two times as great in the south as in the central part of the state. Occasionally large flocks of flickers may be found even in the north in winter (Blake 1948).

Early in this century, when corn was hand picked and large areas were left with stalks standing, cornfields were a favorite winter habitat for flickers (Table 3). Corn stubble left from mechanically picked corn does not support nearly such high population densities of flickers. However, it is still an important foraging habitat because there is so much of it, and it is still used even though at low densities. Forest, shrub areas, and pastures are also regularly used

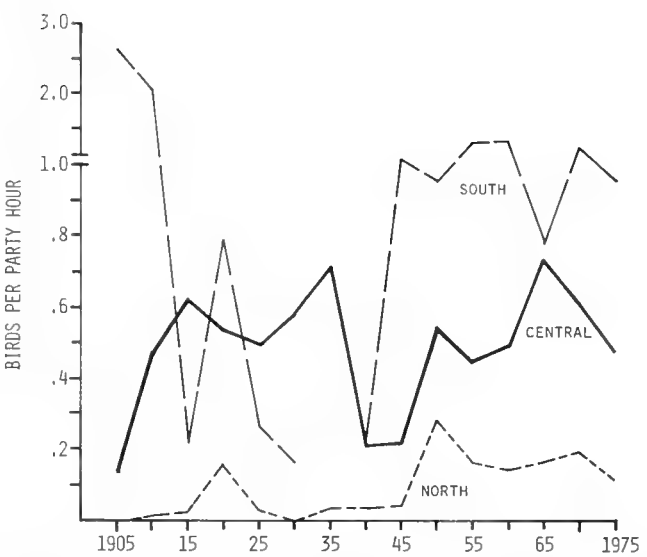

Fig. 6.—Yellow-shafted flickers seen per party hour on Audubon Christmas counts in the three regions of Illinois. Each point represents a 5-year average.

winter habitats. In the south we have found bottomland forest to have consistently higher populations of flickers than upland forest (Table 3). Urban habitat appears less important to the flicker in winter than in summer. The reference in Graber & Graber (1963: 474) to hayfields as winter habitat for flickers, including the population density cited (6 birds per 100 acres) is erroneous. Hayfields are not important as winter habitat, and we are totally at a loss to explain the error.

Winter flicker populations in five upland and eight bottomland woods in southern Illinois were examined to see if any correlation existed between the bird and the woody vegetation in these woods (see introduction). Flicker populations were also compared with those of other woodpeckers in the same woodlands. The only correlation found ($r = 0.597$, $P = <0.1$) indicated that flicker populations are highest in bottomland woodlands that have over 20 percent of the basal area of their trees in the small tree category. Winter numbers were 5–13 times as great as those in summer in these bottomland woods and 7–8 times as great as those in summer in the upland woods.

Though at least part of the Illinois breeding population of flickers winters well south of Illinois (see under Fall Migration), the sources of the Illinois winter population are not known.

Food Habits

The flicker is well known as a consumer of ants (Forbes 1882*a*; Ekblaw 1919). Gross & Forbes (1909) stated that ants made up 45 percent of the flicker's diet. Much of the food is taken from the ground. A specimen taken in Tazewell County 24 May 1881

TABLE 3.—Winter populations of yellow-shafted flickers in various Illinois habitats.

Habitat	Acres	Birds per 100 Acres	Years (January)	Type of Census	Region or County	Reference
Urban residential	191	0.5	1976	Strip	Central	This paper
Urban residential	191	1	1976	Strip	South	This paper
Suburban woodlot	20	0–5	1968–1972	Map	Lake (N) [a]	Miller & Miller 1968, 1970
Oak-maple forest edge	55	0–16 (avg 7.3)	1925–1943	Map	Champaign (C)	Kendeigh 1948*a*
Oak-maple forest edge	1.25 miles[b]	0–1[b] (avg 0.2)	1944–1948	Map	Champaign (C)	Kendeigh 1948*a*
Oak-maple forest edge	1.25 miles[b]	0–3[b] (avg 1.4)	1949–1975	Map	Champaign (C)	Kendeigh & Brooks 1963*a*; Kendeigh, James, & Weise 1953
Forest (all types, including edge)	110	0	1907, 1957–1958	Strip	North	Graber & Graber 1963
Forest (all types, including edge)	152	0–1 (avg 0.5)	1957–1958	Strip	Central	Graber & Graber 1963
Forest (all types, including edge)	241	2	1907	Strip	South	Graber & Graber 1963
Forest (all types, including edge)	211	2–7 (avg 3.8)	1957–1958	Strip	South	Graber & Graber 1963
Mature upland oak-hickory forest	772	0–11 (avg 2.5)	1974–1976	Strip	South	This paper
Mature bottomland forest	1,398	0–24 (avg 5.3)	1974–1976	Strip	South	This paper
Bottomland woods	50	(+) [c]–2	1950, 1953	Map	Cook (N)	Montague 1950, 1953
Virgin bottomland forest	50	4	1947	Map	Piatt (C)	Fawver 1947*b*
Grazed bottomland woods	53	2	1955–1957	Map	Macon (C)	Chaniot & Kirby 1955*a*, 1956; Kirby & Chaniot 1957
Shrub area	87	0	1957–1958	Strip	North & Central	Graber & Graber 1963
Shrub area	101	2–5 (avg 3.0)	1957–1958	Strip	South	Graber & Graber 1963
Shrubby field and forest edge	85	(+) –1	1955–1956	Map	Richland (S)	Shaw & Stine 1955; Shaw et al. 1956
Shrubby field	40	(+) –2	1960–1965, 1968	Map	Lawrence	Shaw 1961, 1962
Pasture	440	(+)	1907	Strip	North	Graber & Graber 1963
Pasture	343	1	1907	Strip	Central	Graber & Graber 1963
Pasture	208	3	1907	Strip	South	Graber & Graber 1963
Pasture	93	1–4 (avg 2.1)	1957–1958	Strip	South	Graber & Graber 1963
Cornfields (harvested)	491	(+)	1957	Strip	Central	Graber & Graber 1963
Cornfields (stalks standing)	222	8	1907	Strip	South	Graber & Graber 1963
Cornfields (stalks removed)	117	2	1907	Strip	South	Graber & Graber 1963
Cornfields (machine picked)	277	1–2 (avg 1.4)	1957–1958	Strip	South	Graber & Graber 1963

[a] N refers to the northern region of Illinois, C to the central region, and S to the southern, as shown on winter distribution maps, e.g., Fig.5.
[b] These entries are miles of forest edge and birds per mile of edge.
[c] The plus symbol (+) indicates fewer than one bird per 100 acres.

had eaten nothing but ants. Similarly, a male from Champaign County on 3 October 1968 had packed in its stomach and esophagus 20 milliliters of ants (mainly adults with some pupae), 90 percent of which were one species of *Formica,* plus species of *Lasius* and *Acanthomyops.* (A species of *Lasius* was also used in anting by a flicker (Southern 1963)). This bird's food and its fresh undigested condition indicated that the bird had fed in several different areas in a brief span of time and in different habitats from open fields to woods (Wallace E. LaBerge, Illinois Natural History Survey, personal communication). Forbes (1881) found no indication of predation on canker worms by a flicker taken in a heavily infested orchard. In the deep south, at least, the flicker is a very important predator on corn borers (Black et al. 1970), and though this has apparently not yet been reported in Illinois, the large winter population of flickers in corn stubble in Illinois may relate to such predation. In Georgia flickers have also been observed feeding on corn ear caterpillars of an undesignated species (Dorsey 1925), and flickers are an important predator on the southwestern corn borer in Arkansas (Wall & Whitcomb 1964).

Beal's (1911) extensive study of the food of North American woodpeckers includes some data on Illinois specimens. Beal found that the yellow-shafted flicker's diet was about 61 percent animal matter and 39 percent vegetable. Ants were clearly the favorite food every month, comprising about 50 percent of the year's diet and going as high as 80 percent in May and as low as 11 percent in December. Predaceous

ground beetles (Carabidae), Hemiptera (chinch bugs), and Orthoptera (grasshoppers, crickets) were regular items in the diet in small amounts.

Small, mainly wild, fruit was important in the flicker's diet from summer to October, when such fruit constituted about 42 percent of the food. Especially important were species of *Rubus* (blackberries, raspberries, etc.) and *Rhus* (poison ivy, sumac), plus wild black cherries, hackberries, grapes, and dogwood. The flicker may be an important agent in the distribution of such plants. In the fall we have often seen flickers feeding on the fruit of poison ivy. They also eat pokeberries and wild grapes (Comfort 1940), and Gault (1932) found one eating pears on a tree. Flickers are also fond of suet (Patterson 1923). There is no definite reference to the use of mast by flickers in Illinois in contrast to the abundant literature on the subject for red-headed woodpeckers.

Longevity and Mortality

Survival and longevity of flickers have not been studied systematically on a population basis in Illinois. The two oldest flickers for which band recoveries have been published were at least 7 years and 1 month (Lyon 1925) and 5 years (Remington 1944). The remains of at least a few flickers have been found in Indian kitchen middens dating back perhaps 10,000 years (Baker 1936; Parmalee 1959, 1962, and 1969). More recent problems with humans relate to possible insecticide poisoning (Scott et al. 1959) and highway mortality (Flint 1926 and 1934–1935; Komarek & Wright 1929; Blocher 1936*a;* Starrett 1938). Some flicker mortality has been ascribed to severe weather in winter and spring (Schafer 1921; Roseberry 1962).

The screech owl and red fox have been recorded as predators, or at least scavengers, on flickers in southern and central Illinois (Brown & Bellrose 1943; Knable 1970). Coffin (1970) described a strange interplay, apparently unrelated to predation, between a flicker and a sparrow hawk. Perhaps unique was the instance of a flicker made unable to fly because of heavy poplar resin accumulations on its wings and tail (Brodkorb 1928).

The only reference we've found on the pathology of flickers in Illinois is Labisky & Mann (1961) on a case of avian pox.

RED-SHAFTED FLICKER
(*Colaptes auratus* subspecies)

There are a number of Illinois records of flickers with reddish color in their flight feathers (Ridgway 1914; Lyon 1934; Labahn 1941; Comfort 1949; Mumford 1959*a* and 1959*b;* Southern 1962; Petersen 1966 and 1967; Anderson 1966 and 1971; Fawks 1967; Test 1969; Hamilton 1969; Kleen & Bush 1971). The genetic constitution of Illinois red-shafted flickers is unknown, but presumably includes mainly hybrids between *auratus* and *cafer*. In those cases where red-shafted specimens have been examined 'in hand,' they have invariably proved to be hybrids (Ridgway 1881 and 1914; Lyon 1934 and 1934–1935; Labahn 1941; Coursen 1941; Southern 1962; Test 1969). There is no certain way to differentiate specimens (even in hand) of pure *cafer* from hybrids close to the *(cafer)* parental stock, and virtually every conceivable stage of intermediacy between *cafer* and *auratus*

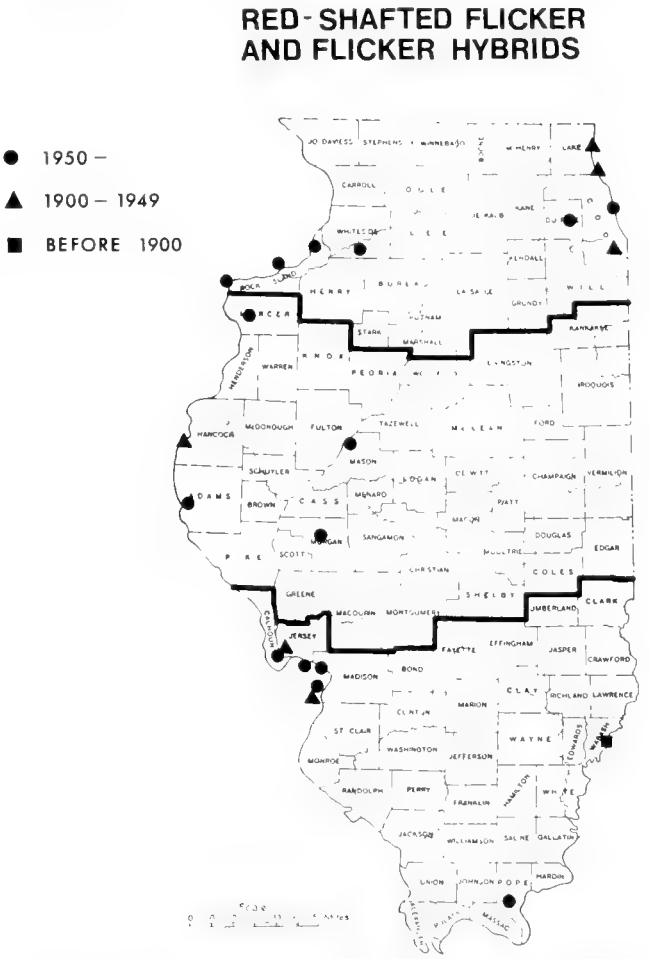

Fig. 7.—Distribution of records of red-shafted and hybrid flickers in Illinois. Heavy horizontal lines separate the three regions of the state.

has been recorded in the hybrid zone (Fig. 2). Hybrids close to *auratus* are probably regularly misidentified in the field as *auratus.* The only attempt to determine frequency of hybrid types among Illinois flickers was that of Ridgway (1881), who examined 30 specimens collected in the fall near Mt. Carmel and found only one that showed any sign of hybridization. However, he thought 1 in 200 a more likely incidence of the hybrid phenotype.

Red-shafted birds are most often reported in the fall, but a few may overwinter in Illinois (Fawks

Fig. 8.—Pileated woodpecker at its nest. Photo taken in June, 5 miles north of Golconda, Illinois. This large woodpecker is about the size of a crow.

1967; Petersen 1967), especially in the west and southwestern parts of the state.

The dates of reports of "red-shafted" flickers extend from 30 August to 22 May, and the distribution of these records is shown in Fig. 7. The influx of these reddish-shafted birds would seem to indicate that at least some of our winter flickers are from the north or northwest.

There are two obviously erroneous reports of red-shafted flickers in the literature in the Christmas counts, namely the Danville count for 1954 (Anonymous 1955) and the Princeton count for 1958 (Kramer 1959). In both cases 10 red-shafted but no yellow-shafted flickers are listed.

PILEATED WOODPECKER
(Dryocopus pileatus)

(Cover and Fig. 8 and 9)

Distribution

The pileated woodpecker is widely distributed in the forested regions of North America (Fig. 9). The distribution of the pileated, despite its conspicuousness is poorly known in Illinois (Fig. 10).

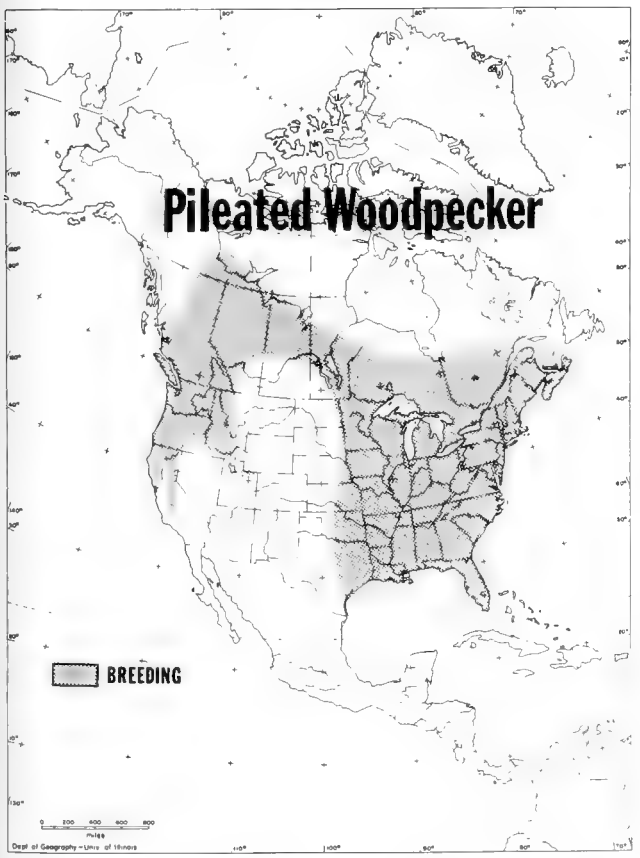

Fig. 9.—General distribution of the pileated woodpecker. The range shown here may include large sections in which populations of the species are thin or even absent because of the nature of the terrain and lack of suitable habitat.

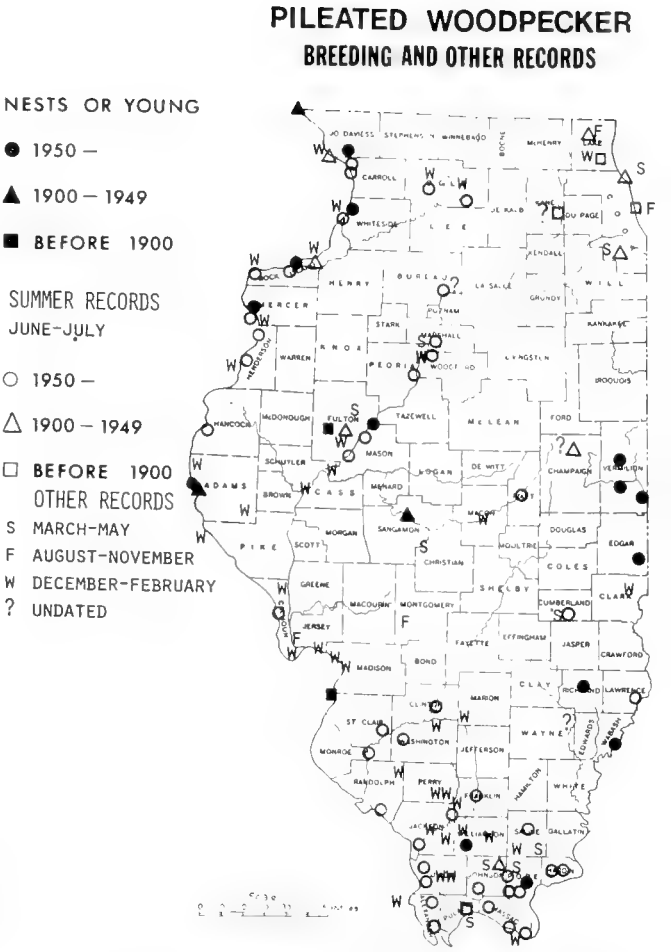

Fig. 10.—Breeding and other records of the pileated woodpecker in Illinois. Since the bird is non-migratory, winter, spring, and fall records have been added to show the pattern of distribution more clearly.

There is no evidence of migration by any Illinois population of the pileated woodpecker. Fluctuations in the spring and fall counts of pileateds (Fig. 11) were probably related to seasonal changes in behavior which affected the conspicuousness of the bird rather than to changes in numbers. Our counts definitely increased at times when the species became noisy, either calling or drumming. In New York, Hoyt (1941) found that pileateds remained in the same area throughout the year. Though we have plotted winter records separately (Fig. 12), in view of the species' sedentary nature the winter records may also be indicative of breeding populations. Consequently, we have included some winter, as well as spring and fall, records in Fig. 10 to provide a more complete picture of the pileated's distribution.

Within historic times the pileated has undergone at least one major cycle of distribution regression and re-expansion in Illinois. The picture is somewhat complicated in that perhaps two distinct populations were involved, the northern *(D. pileatus abieticola)*

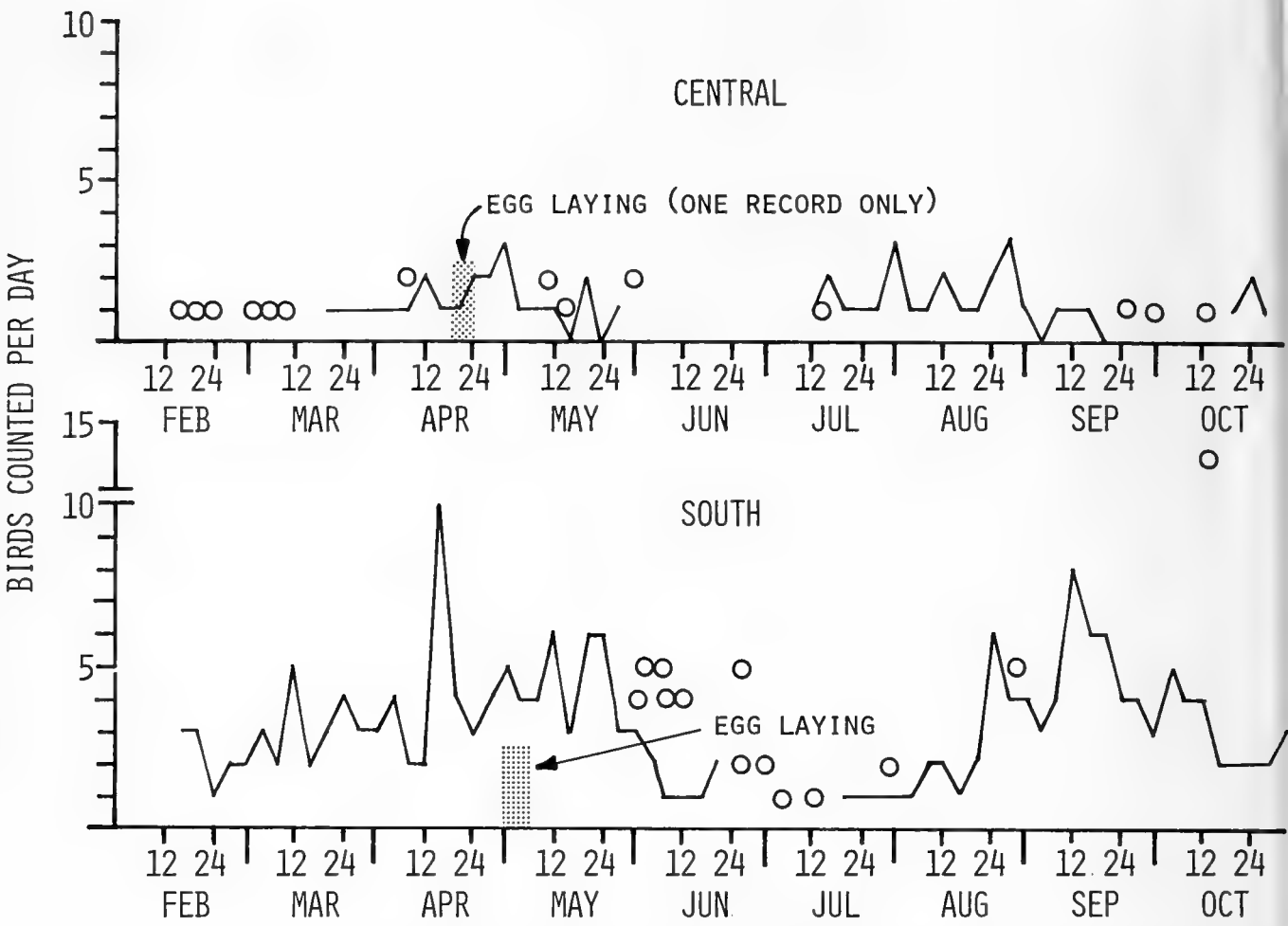

Fig. 11.—Numbers of pileated woodpeckers seen in spring, summer, and fall in central and southern Illinois. The graph line represents the higher daily count of each 4 days made by R. R. Graber in 1967 and 1970 in southern Illinois and in 1969 in central Illinois. Hollow circles represent counts made in other years or by other observers. The egg-laying period (shaded area) shown is very short because of the paucity of records.

and the southern *(D. p. pileatus)* forms of the species. The distribution of the two has never been known except at the northern and southern ends of the state. Kennicott (1853–1854), referring presumably to the northern race, stated that it was formerly not uncommon in Cook County, and forest was sufficiently extensive in the first half of the 19th century to support populations in the northern tier of counties, in Ogle and Kane counties and down the Mississippi valley (Anderson 1970). In northeastern Illinois Nelson (1876–1877) found the pileated to be a rare winter visitant. There is no indication that the northern race has been common in Illinois since then except near the Mississippi, where the species may have sustained itself through the years (Johnson 1936 and 1941).

In the south Ridgway (1881*a*) found the southern pileated to be sixth in abundance of the common species of woodpeckers, though in some localities fourth or fifth, which is very similar to its present ranking. Ridgway (1915) later noted that the pileated population had become much reduced. Vandercook (1919) observed a similar reduction on the Kaskaskia River. In central Illinois Strode (1911) noted the disappearance of the pileated on the Spoon River about 1900. The noted oologist R. M. Barnes (1890 and 1912) did not find the species in Marshall County, nor did Loucks (1891) in the Peoria area. The timing of these observations suggests that all of the authors were witnessing the same change. The cause of the change can only be surmised, but it was probably related to the pileated's requirement of extensive forest habitat and the widespread deforestation of Illinois in the 19th century (Graber & Graber 1963). The declining trend in forest acreage was reversed between 1910 and 1920 (King & Winters 1952), after which pileated habitat probably improved both in quality and quantity. The woodpecker responded, and Jones (1934) made an early reference to its recovery in the St. Louis area, where much earlier Hurter (1884) had found the pileated rare. Musselman (1926) suggested that the pileated

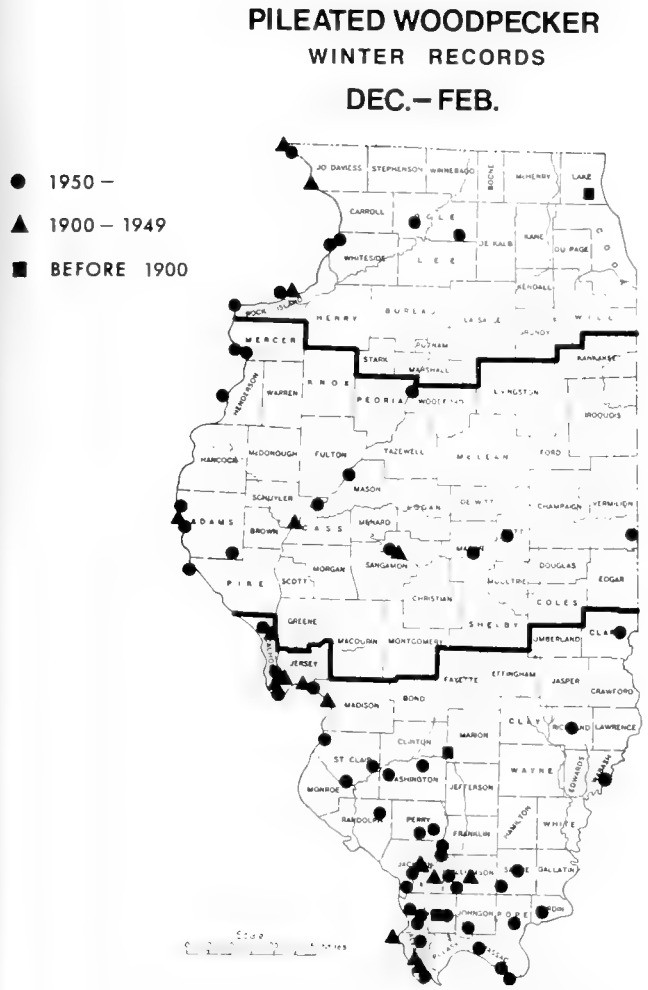

Fig. 12.—Winter records of the pileated woodpecker in Illinois. Heavy horizontal lines separate the three regions of the state.

may never have disappeared from the heavily wooded islands of the Mississippi near Quincy. In the 1950's and 1960's the expanding population of pileated woodpeckers was noted by many observers (Mayfield 1951; Nolan 1955; Petersen 1964) as far north as Rock Island, Whiteside, and Marshall counties (Shaw 1959; Brown 1964; Fawks 1967).

Except for northwestern Illinois, the population expansion appears to have come from the south, i.e., *D. p. pileatus* moving northward along major streams. With the exception of northeastern Illinois, the range of this species is probably now near its maximum 19th century limits, reaching north into Vermilion and Piatt counties in the east, at least to Putnam County on the Illinois River, and the full length of the state on the Mississippi (Fig. 10 and 12). The recent Ogle County records are particularly interesting in view of the complete absence of records for Winnebago County. This suggests expansion from the south along the Rock River, which is thinly forested in many places.

There is no evidence that pileateds ever occupied at any significant or sustained population level the prairie peninsula of eastern Illinois from Kane County south to Iroquois, Champaign, and McLean counties.

Nesting Habitats and Populations

There is a strange dearth of references to the pileated woodpecker's habitat in Illinois. Only Ridgway (1889), in referring to the habitat as "the more heavily timbered portions," and Musselman's (1926) reference to "heavy woods on the Mississippi River islands" indicate the habitat.

Judging from population densities in southern Illinois (Table 4), we conclude that bottomland forest is definitely favored over upland by pileateds. An old bottomland forest, Beall Woods (Wabash County), had the highest population (6.9 pileateds per 100 acres) of any area censused.

Our studies on bird populations in relation to forest vegetation in southern Illinois showed that pileated woodpecker populations were poorest in those bottomland forests with a high Importance (Y) of oak-hickory. The correlation *(r)* between pileated populations and oak-hickory in eight forest study areas was -0.780 ($P = 0.02$). No pileateds were detected in two bottomland forest areas which had oak-hickory Importance values of 64.2 and 97.8. Importance of oak-hickory in woodlands *with* pileateds was 26.5, 32.7, 50.0, 34.8, 28.9, and 31.0 (listed in descending order of pileated populations). Pileated populations were higher in woods having a more even balance between oaks, hickories, maples, elms, *Celtis,*

TABLE 4.—Breeding populations of pileated woodpeckers in various Illinois habitats.

Habitat	Acres	Birds per 100 Acres	Years	Type of Census	Region or County	Reference
Forest (all types, including edge)	340	1–2 (avg 1.5)	1957–1958	Strip	South	Graber & Graber 1963
Virgin bottomland forest	77	3	1948	Map	Sangamon (C) [a]	Snyder et al. 1948
Mature bottomland forest	913	0–7 (avg 1.2)	1974–1975	Strip	South	This paper
Mature upland forest	479	0–0.5 (avg 0.2)	1974–1975	Strip	South	This paper

[a] C refers to the central region of Illinois, as shown on winter distribution maps, e.g., Fig. 5.

ashes, and sweet gums. There was a positive correlation between the number of pileated woodpeckers and the number of large (over 22 inches DBH) *Celtis* ($r = 0.894$, $P < 0.01$) in bottomland tracts.

It is not surprising that pileated populations were much lower in upland forest (Table 4), where oak and hickory are the characteristic dominants. The only upland woods (of five censused) having a measurable pileated population within the census transect was adjacent to a bottomland with a high population of pileateds. This upland woodland also had a more balanced tree composition than most uplands, with the Importance of oak-hickory being only 39.8. For the upland study areas lacking pileateds, oak-hickory Importance ranged from 54.5 to 87.0. Where pileateds are found in hill land, they frequent the valleys and ravines, where oak-hickory usually constitutes less than 40 percent of the tree flora (Voigt & Mohlenbrock 1964).

How large a forest tract is required to sustain a pileated population is unknown. No measurements of pileated populations exist for northern Illinois. Territory size has not been measured in any Illinois population of pileateds.

We have nest-site data for only 12 pileated nests in Illinois. All were located in live sycamores or dead trees and trunks. Heights of nests ranged from about 10 to 90 feet (Strode 1911), being higher in northern and central Illinois (average for three nests: about 60 feet if the 90-foot figure is true), than in the south (average for six nests: about 25 feet).

Nesting Cycle

Nothing has been recorded on the nesting cycle of the pileated woodpecker in Illinois. For data on populations elsewhere see Hoyt (1941 and 1944), Hoyt (1957), and Kilham (1959).

In southern Illinois pileateds become particularly noisy in March, loudly calling and giving their distinctive "drum roll." This behavior may mark the onset of nesting activity. Kilham (1959) has observed mating in Maryland in late March. Off and on through most of the year the commonest calls heard suggest alarm—loud "kuk-kuk" notes, sometimes rising and slurred into a high cackling sound. Also through the year, but more frequently in the spring, we hear the loud, high, rolling "song" suggestive of the flicker's "song" but much more clarion.

On the basis of fledging dates and incubation (18 days) and nesting (26 days) periods given by Hoyt (1944) and Hoyt (1957), we conclude that egg laying occurred about 20 April at one nest in central Illinois and 1–6 May at two nests in southern Illinois. We would expect laying to begin much earlier in south than in central Illinois.

While photographing pileateds at a nest in Pope County, we observed a pair trade places in brooding the young. The male was in the cavity when the female alighted quietly on the back side of the nest tree. Within a few seconds the male left silently. As there had been no vocalization or tapping and as the male could not have seen the female, he must have heard her land on the trunk. The female waited for about 1 minute after the male departed, then came around to the nest entrance and went in. Both adults also fed the young, bringing food so enclosed in their bills that we could not identify it. When the adults landed on the nest tree, we could hear the young utter a buzzy whirring sound audible at least 25 feet from the nest.

There are no Illinois data on nesting success or productivity.

Fall and Winter Populations

The dispersal of pileated woodpeckers in fall or winter has not been substantiated with banded birds, but there is other evidence of some movement—notably the occasional appearance of pileateds in urban areas in winter and a slight increase in the pileated population in upland forest and a decrease in bottomland forest, compared with summer levels (Tables 4 and 5).

The ratio of our spring (March–May, inclusive) to fall (August–October) counts of pileateds in southern Illinois was 1.0 (spring) to 1.2 (fall), suggesting modest productivity in summer. There is a definite resurgence of drumming by pileateds in September and October, making them conspicuous and probably affecting the counts, but as there is also much drumming in spring, the effect may be evened out. Surprisingly, our data show little difference between summer and winter in the total population of

TABLE 5.—Winter populations of pileated woodpeckers in various Illinois habitats.

Habitat	Acres	Birds per 100 Acres	Years (January)	Type of Census	Region or County	Reference
Forest (all types, including edge)	241	1	1907	Strip	South	Graber & Graber 1963
Forest (all types, including edge)	211	0	1957–1958	Strip	South	Graber & Graber 1963
Mature bottomland forest	1,398	0–7 (avg 0.9)	1974–1976	Strip	South	This paper
Mature upland forest	772	0–2 (avg 0.3)	1974–1976	Strip	South	This paper

pileateds when we apply density figures to the appropriate habitat acreages (Graber & Graber 1976). Summer populations were slightly higher, perhaps indicating that most of the production of young has occurred by June.

Cooke (1885*b*) saw 5–15 pileateds per day in winter in Union County—a high population area, where we have seen lower numbers (peak: 7 per day) in recent years.

Winter pileated woodpecker populations are highest in bottomland forests with large trees (Fig. 13). In seven of eight bottomland tracts that we studied in southern Illinois a positive correlation existed between the number of large trees (over 22 inches DBH) and the number of pileateds encountered per hour of censusing ($r = 0.960$, $P < 0.001$). A positive correlation also appeared between pileated numbers and the Importance (see Introduction) of *Celtis* ($r = 0.779$, $P < 0.05$) and *Ulmus* ($r = 0.702$, $P = 0.05$). As in summer, there was a negative correlation between numbers of pileateds and the Importance of oak-hickory. Habitat preference apparently does not change greatly between summer and winter in this species in contrast to those of most other woodpeckers.

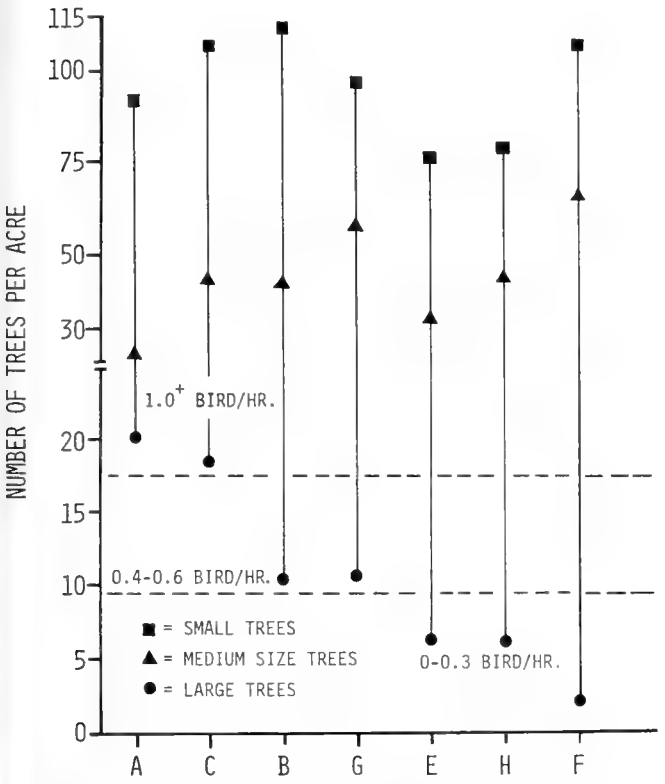

Fig. 13.—Correlation between winter numbers of pileated woodpeckers and sizes of trees. Each vertical line represents a separate bottomland forest. The square, triangle, and dot on each line show size classes of trees with the square representing trees 4–10 inches DBH; the triangle, trees 10–22 inches DBH; and the dot, trees over 22 inches DBH. The horizontal dash lines divide population levels of pileated woodpeckers. Letter designations refer to specific forest tracts identified in the introduction.

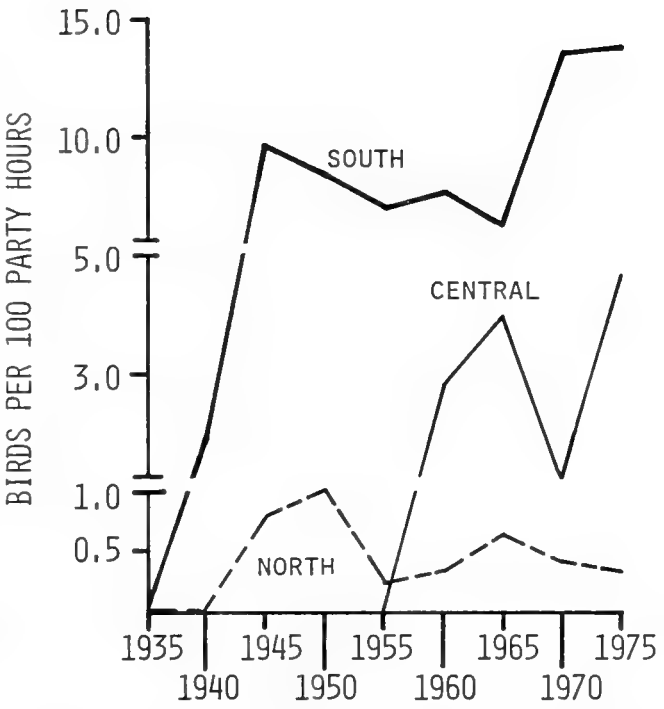

Fig. 14.—Pileated woodpeckers seen per party hour on Audubon Christmas counts in the three regions of Illinois. Each point represents a 5-year average.

The Christmas counts for the pileated woodpecker show the highest annual variation of those for any of the common woodpeckers. Annual variation in the counts for the past 10 years ranged from 0 to 279 percent (mean = 74 percent) in northern Illinois, 14–160 percent (mean = 70) in central Illinois, and 11–648 percent (mean = 114) in the south. Our own winter censuses show only about 25 percent annual variation. The Christmas counts show a population gradient, declining from south to north (Fig. 14). The species was first detected on a count made much later in central Illinois (1955) than those on which it was first found in the north and south (1940 and 1928, respectively), possibly reflecting the expansion of two populations, one from the north and another from the south with the central region being the last reached from either end.

We have but one observation on roosting by a pileated woodpecker. At 4:25 p.m. CST on 22 November in Pope County, a pileated entered a roosting cavity about 25 feet high in a dead stub, which had also been used during the summer as a nesting site (in a different cavity 11 feet high).

Food Habits

The only Illinois reference we have found to the food of the pileated woodpecker is that of Cooke

(1885*b*), who found that winter specimens from Union County were filled with ants. The stomach of a March (1977) specimen from Vermilion County was packed with carpenter ants (*Camponotus herculeanus*). Beal's (1911) study of 80 North American specimens also showed ants to be important in the diet. He found the pileated's food to be about 73 percent animal and 27 percent vegetable matter. The animal food was about 40 percent ants and 22 percent beetles—especially the larval stages of wood borers of the families Cerambycidae, Buprestidae, and Elateridae, probably taken mainly from dead or decaying wood. The ants also were of the larger species found on and in decaying wood. In one stomach Beal counted 2,600 ants. Other animal food included flies, caterpillars, grasshoppers, and termites. Musselman (unpublished notes 1968) observed pileated woodpeckers feeding on suet. He also witnessed a red-headed woodpecker chasing a pileated from the suet feeder.

The vegetable food was virtually all wild fruit, such as hackberry, smilax *(Smilax),* blackberry, sumac and poison ivy, holly *(Ilex),* grape, dogwood, tupelo, persimmon, sassafras, elderberry *(Sambucus),* and haw *(Viburnum),* all common plants in Illinois.

In their search for borers, pileateds often make distinctive large holes (Fig. 15) in infested trees. We have noted these characteristic holes most often on sassafras, box elder, ash, cottonwood, Kentucky coffee tree, and beech.

Beal (1911) concludes his remarks on the pileated with an appeal for the species' protection. Unfortunately, pileated woodpeckers are often shot, because of their large size, by ignorant hunters. Musselman (1933) refers to four being shot in 1 week near Quincy. Pileated remains have been detected among Indian middens dating back perhaps 10,000 years (Parmalee 1959; Noyes & Hill 1974).

Specimen Data

Because of the paucity of preserved specimens, it is still uncertain whether there are (or were) two distinct populations of pileated woodpeckers in Illinois. We have examined 20 Illinois specimens, of which 18 were in adult (i.e., not obviously immature), not obviously worn, plumage (Table 6). Three of the male specimens—all collected before 1900—fall within the size range of the northern form, *Dryocopus pileatus abieticola,* as given by Ridgway (1914). The distribution of these specimens indicated a range for that race of extreme northern Illinois, south along the Mississippi valley to at least Hancock County. These large males also (as in *abieticola*) have a slightly grayer tone of body plumage than have specimens from southern Illinois. All other Illinois specimens—central and southern Illinois, male and female—fall within the size range of *D. p. pileatus* (Table 6 and Ridgway 1914). These central and southern

Fig. 15.—Typical pileated woodpecker work on a red oak on the Ohio River bank at Golconda, Pope County, Illinois.

TABLE 6.—Measurements of Illinois specimens (plus one from adjacent Indiana) of pileated woodpeckers, excluding obviously worn, molting, and juvenile specimens.

Region of Illinois	Months	Number of Specimens	Sex	Wing (Chord) in mm			Tail Length in mm			Culmen (from Naris) in mm		
				Range	Mean	SD	Range	Mean	SD	Range	Mean	SD
North and Mississippi valley of Central	Nov.–Mar.	4	M	229–245	237.1	6.51	153–163	159.3	4.86	43–53.5	48.2	4.15
South and Central (except Mississippi valley)	Sept.–May	7	M	217–234	224.7	6.24	148–157	153.1	4.25	42–47	44.9	2.41
South and Central (except Mississippi valley)	Oct.–May	8	F	213–226	218.3	4.17	140–152	147.2	3.58	36–43	40.7	2.07

Illinois specimens have almost the same size range as have Kentucky specimens (Mengel 1965) if we use mean wing length $\pm$ 3 SD to indicate the maximum range for the population. Within this maximum range, however, would be all of the Illinois specimens but one, including even the northern specimens. We have seen no recent (since 1900) specimen showing the characters of *abieticola*.

We have found weight data on only four adult specimens—three females: an April specimen from Cumberland County, 262.2 grams; a May specimen from Sangamon County, 237.4 grams; and one March specimen from Pope County, 223.5 grams. The fourth, a male, was a March specimen from Vermilion County that weighed 278.6 grams. An immature female from Jackson County, probably near the end of the post-juvenile molt, weighed 209.5 grams.

RED-BELLIED WOODPECKER
(Centurus carolinus)

(Fig. 16 and 17)

Spring Populations

Do red-bellied woodpeckers migrate in Illinois? A few authors have suggested that they do (Nelson 1876–1877; Cooke 1888; Smith & Parmalee 1955). Hess (1910) admitted that he was uncertain about the matter, and there are no published records to indicate that the migration has been observed directly. We have seen what we assumed to be diurnal migration of a few red-bellied woodpeckers on the "blue jay routes" of the Mississippi and Ohio valleys, but only in fall (Fig. 18). There is no positive evidence of nocturnal migration by the species (see Fall Migration). Red-bellied woodpeckers do not vacate any sizeable part of Illinois in winter, and the spring populations do not show a pronounced migration peak like those of the strongly migratory flicker and red-headed woodpecker (Fig. 3 and 26).

The highest spring counts of red-bellies have been recorded in February and March (Fig. 18), months for which we have only fragmentary data. If a migration occurs in that period, it is conspicuously earlier than the spring flights of the red-headed woodpecker and the flicker. Fluctuations in spring populations of the red-belly could be accounted for by behavior other than migration, but students should continue to look for the migration. As the red-belly is increasing its populations northward, it is possibly now evolving migratory behavior.

Distribution

There is evidence that the red-bellied woodpecker has been slowly expanding its range northward in Illinois for more than a century, and it has met with increasing success in the past half century. Within historic times it has been abundant in southern Illinois (Ridgway 1881*b*) with the population developing later in central and northern Illinois. Kennicott (1853–1854) made no mention of the species in northeastern Illinois, where Nelson (1876–1877) called the species rare in summer but not uncommon during migration. Later, Woodruff (1907) considered it only a rare migrant in the Chicago area. Farther south the renowned oologist R. M. Barnes (1890) had never found a red-bellied woodpecker nest in Marshall County, and Loucks (1892 unpublished manuscript) found the species rare in Peoria and Tazewell counties. However, by 1905 Barnes (unpublished note 1905) observed it increasing, and by 1912 the species had become a common nester in the Illinois River bottoms of Marshall County (Barnes 1912). Away from the Illinois River in Logan County red-bellies were still rare in 1918 (Du Bois 1918). The range expansion appeared to progress even better on the Mississippi than in the Illinois River valley, as Schafer (1918) was seeing 6–10 red-bellies per day during February and March, 1918, near Port Byron. He also recorded red-bellies on 6 of 10 breeding bird censuses between 1914 and 1923 (Table 7). At the same latitude on the eastern side of the state at Orland (Cook County), red-bellies were still uncommon as late as 1947 (Coursen 1947) though they

were believed to be increasing (Moseley 1947). Charles T. Clark (personal communication 1975) noted that the red-bellied woodpecker population in Cook County began an accelerated increase in 1956. Our cross-country census of 1957–1958, which covered 177 acres (16.2 miles) of forest in the two northern

Fig. 16.—A red-bellied woodpecker on a fallen tree at Allerton Park, Piatt County, Illinois, in October. Black middle rectrices are missing, as the bird is in molt.

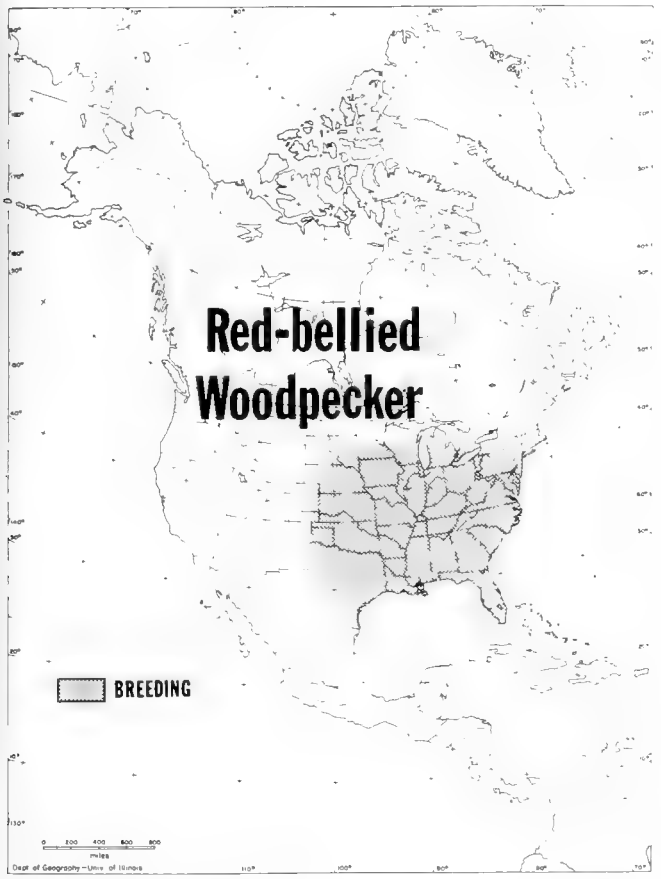

Fig. 17.—General distribution of the red-bellied woodpecker. The range shown here may include large sections in which populations of the species are thin or even absent because of the nature of the terrain and lack of suitable habitat.

tiers of counties, did not intercept a red-belly within the transect, but the census did not include extensive riparian forest. There is a need for more recent population data on the red-belly in the north to compare with those of Schafer (Table 7). The picture of the red-bellied woodpecker's range expansion in the north appears to be one of surges and declines, with larger populations along the major rivers. The population is apparently still very thin in the north by comparison with that of central Illinois.

The red-bellied woodpecker is an eastern U.S. species (Fig. 17). In Illinois it probably nests in every county though records are still lacking for many (Fig. 19). In addition to the records plotted in Fig. 19, there is a definite nest record for Lake County for which the specific locality was not given (Goelitz 1917).

Nesting Habitats and Populations

In summer the red-bellied woodpecker is essentially a bird of the forest interior (Kendeigh 1944), and Silloway (1922 unpublished manuscript) found it most frequently in large trees of the interior. In southern Illinois red-bellies make some use of shrub habitat and pasture for foraging (Table 7). Red-bellies do not generally inhabit residential areas in summer (Ridgway 1887). They occupy both bottomland and upland forest, but most authors indicate that bottomland is the preferred type (Nelson 1877; Gates 1911; Kumlien & Hollister 1951). In east-central Illinois Hess (1910) found red-bellies only in the wilder timbered bottoms at a time when the species was still expanding its population in that region. Both Barnes (1912) and Yeager (1955) noted that red-belly populations increased where timber was flooded enough to kill trees.

At Morton Arboretum, apparently in upland habitat, Swink (1959) found oaks, especially white oaks, to be the most frequent perching sites for red-bellies. By contrast, Kumlien & Hollister (1951) specifically mentioned maple and ash, in preference to oak, as habitat for red-bellies in heavy bottomland timber.

We measured summer populations of red-bellied woodpeckers in five upland and eight bottomland woods in southern Illinois in 1974 and again in 1975. No correlation was found between numbers of these birds and density or basal area of living or dead trees of any genera or species with one exception. There was a positive correlation between the number of red-bellied woodpeckers per 100 acres in seven of the bottomland woods and the Importance (Y) of maples ($r = 0.793$, $P < 0.02$), particularly silver maples ($r = 0.804$, $P < 0.02$). The highest correlation among different size groups was for maples 10–18 inches DBH ($r = 0.711$, $P < 0.05$). We found no maples in one bottomland woods, which had an average population of red-bellied woodpeckers (see below). The red-belly appears to occupy the maple-ash areas of bottomland woods, while the red-head occupies the oak portions of such woodlands. In a central Illinois woodland, Williams (1975) found that red-bellied woodpeckers spent much time foraging in silver maples, whereas red-heads in the same woodland spent much of their time in oaks. Willson (1970) observed conflicts between the two species in a central Illinois woodland and observed that the red-head usually dominated.

The highest recorded Illinois population for a significant habitat sample was 23 red-bellies per 100 acres in a virgin floodplain elm-maple forest in Sangamon County (Table 7). High populations in individual forest tracts of 50 or more acres were 9–23 birds per 100 acres in both central and southern Illinois bottomland. Average populations from place to place and year to year in bottomland forest were about 6 red-bellies per 100 acres, and average populations in uplands were only slightly lower—4.5 per 100 acres.

Calef (1953*a*) and Stickel (1965) suggested that red-bellies had notably large territories and home ranges. In a mature bottomland forest in McLean County Calef (1953*a*) measured five territories, which

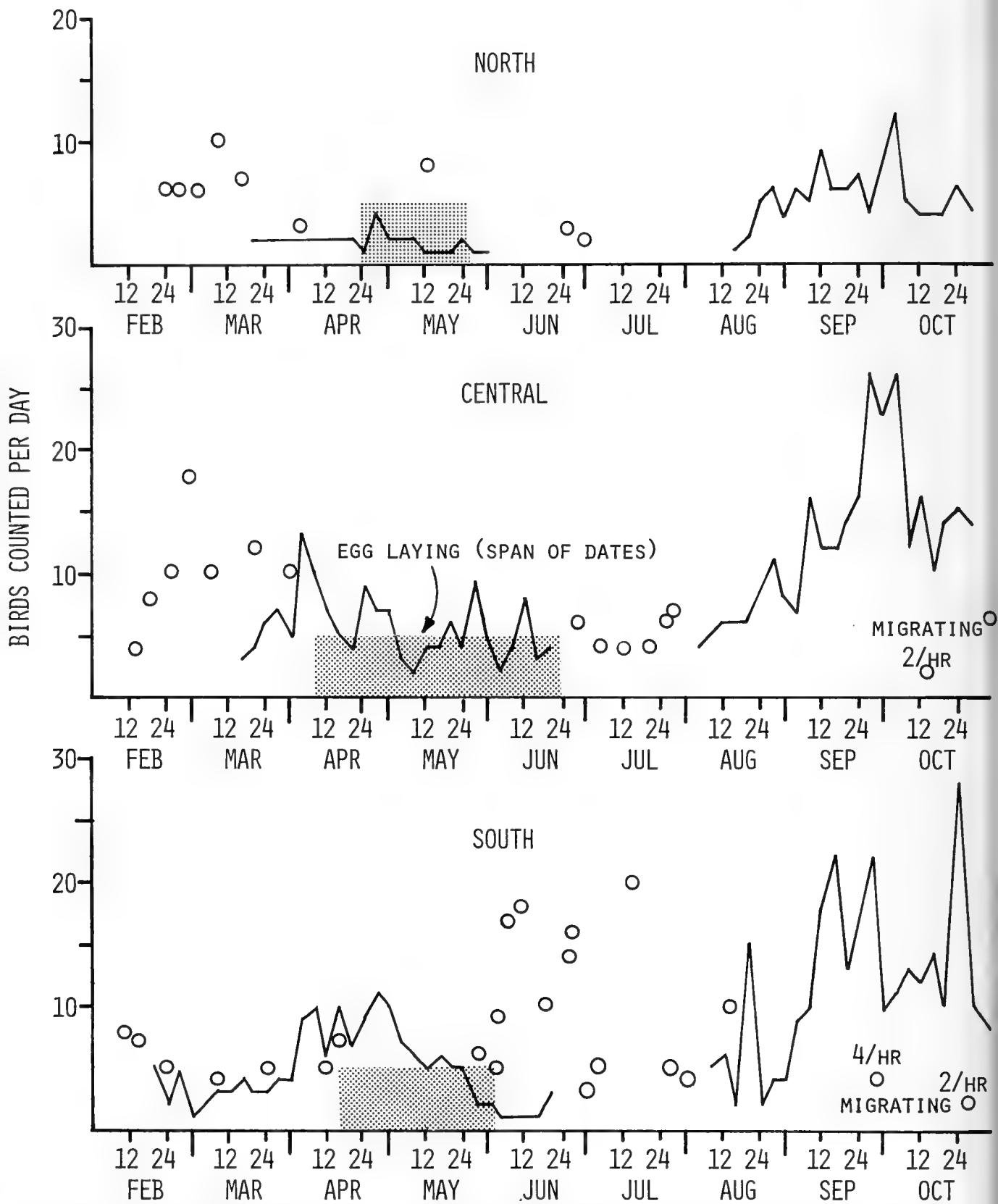

Fig. 18.—Egg-laying season and numbers of red-bellied woodpeckers seen in the spring, summer, and fall in the three regions of Illinois. The spring and fall graph lines represent the higher count of each 4 days (1967–1970). Hollow circles represent counts made in other years or by other observers. Shaded areas show the span of dates during which egg laying has been recorded.

TABLE 7.—Breeding populations of red-bellied woodpeckers in various Illinois habitats.

Habitat	Acres	Birds per 100 Acres[a]	Years	Type of Census	Region or County	Reference
Oak-maple forest	55	0–4 (avg 2.9)	1927–1947	Map	Champaign (C) [b]	Kendeigh 1944, 1948*b*
Oak-maple forest	55	4–18 (avg 7.9)	1948–1974	Map	Champaign (C)	Kendeigh 1960*b*; Kendeigh & Edgington 1974
Oak-maple forest	64	6	1943	Map	Champaign (C)	Johnston 1947
Forest (all types, including edge)	214	4–5 (avg 4.7)	1957–1958	Strip	Central	Graber & Graber 1963
Forest (all types, including edge)	60	5	1907, 1909	Strip	South	Graber & Graber 1963
Forest (all types, including edge)	340	4–6 (avg 5.0)	1957–1958	Strip	South	Graber & Graber 1963
Mature upland forest	479	0–9 (avg 2.7)	1974–1975	Strip	South	This paper
Mature bottomland forest	913	0–11 (avg 4.0)	1974–1975	Strip	South	This paper
Virgin floodplain forest	77	23	1948	Map	Sangamon (C)	Snyder et al. 1948
Virgin floodplain forest	50	12	1947	Map	Piatt (C)	Fawver 1947*b*
Mature bottomland forest	63	11	1950–1951	Map	McLean (C)	Calef 1953*a*
Grazed bottomland woods	53	7	1955	Map	Macon (C)	Chaniot & Kirby 1955*b*
Forest (unspecified)	20	0–10 (avg 3.3)	1914–1916		Rock Island (N)	John J. Schafer (unpublished notes 1914–1923)
Forest (unspecified)	54	0–9 (avg 4.3)	1917–1923		Rock Island (N)	John J. Schafer (unpublished notes 1914–1923)
Upland second-growth oak-hickory	56	4–7 (avg 4.8)	1941–1942, 1944	Map	Sangamon (C)	Robertson 1941*b*, 1942*b*, 1944*b*
Upland second-growth oak-hickory	46	4	1948	Map	Sangamon (C)	Robertson & Snyder 1948
Upland oak-hickory	24	17	1967	Map	Hancock (C)	Franks & Martin 1967
Second-growth hardwood	15	13	1937–1938	Map	Rock Island (N)	Fawks 1937, 1938
Shrubby field and forest edge	60	2	1949	Map	Richland (S)	Stine 1949
Shrub area	39	5	1909	Strip	South	Graber & Graber 1963
Shrub area	129	0–3 (avg 1.5)	1957–1958	Strip	South	Graber & Graber 1963
Pasture	601	(+) [c]	1907	Strip	South	Graber & Graber 1963
Pasture	120	0–1 (avg 0.8)	1957–1958	Strip	South	Graber & Graber 1963

[a] All figures were converted to birds per 100 acres (number of territorial males or nests × 2).
[b] S refers to the southern region of Illinois, C to the central, and N to the northern region, as shown on winter distribution maps, e.g., Fig. 5.
[c] The plus symbol (+) indicates fewer than one bird per 100 acres.

ranged from 2.1 to 5.2 acres and averaged 3.5 acres. In Piatt County Fawver (1947*b*) measured three territories, which averaged 6.1 acres in virgin floodplain forest, and Allison (1947) measured two territories, which averaged 4.4 acres in mature upland forest. There are no data on territory size for southern Illinois. Reller (1972) suggested that red-bellies tend to forage outside the woods in which they nest, perhaps as a mechanism for reducing competition.

Bush (1934–1935) pointed out that an inverse relationship exists between red-belly and red-head populations after the nesting season (see Winter Populations), and the relationship of even the summer populations shows something of the same tendency. The ecological distribution of the two species in summer and winter shows that they tend to complement one another. The broad occupancy of woody habitats by red-heads in summer contrasts to the relatively narrow occupancy of certain forests by the red-belly, while in winter the situation is reversed, the red-belly taking on a broad ecological distribution and the red-head becoming much more restricted to forest. The highest breeding population of red-bellies we found in southern Illinois was in a forest that had no red-heads. Even the geographic distribution of the two populations tends toward segregation, with generally more red-bellies in the southern part of the state, and more red-heads in the northern part of Illinois. Willson (1970) has also observed segregation of the sexes, during foraging, within a red-bellied woodpecker population.

The published and unpublished data presently available to us on nest sites include information on only 31 nests of the red-belly, mainly in central Illinois. Virtually all nests were in dead trees or stubs or dead branches of live trees—notably oak, willow, elm, maple, ash, cottonwood, poplar, sycamore, basswood, and locust (species not specified). In east-central Illinois red-bellies more often used dead limbs of live trees, whereas red-heads nested in the trunks of dead trees (Reller 1972). Heights (usually estimated) of nests varied from 3 to 90 feet and averaged 32 feet. Reller (1972) observed that nests in Piatt and Champaign counties most often faced south or west.

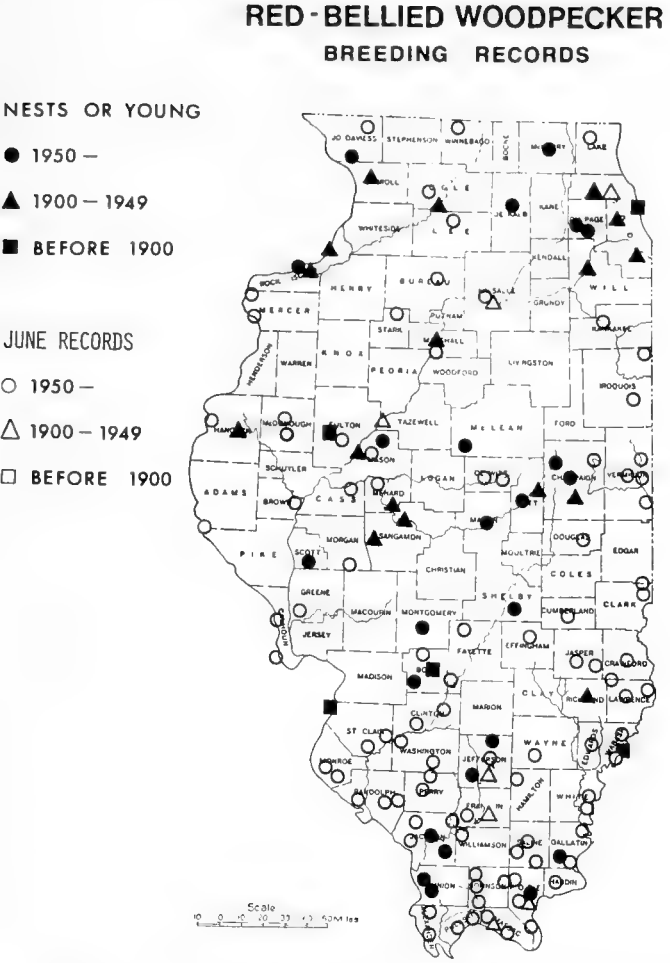

Fig. 19.—Distribution of breeding records of the red-bellied woodpecker in Illinois. Hollow symbols represent birds seen or heard during June.

Nesting Cycle

Most of what is known about the nesting cycle of the red-bellied woodpecker in Illinois comes from a study in southern Illinois by Stickel (1965) and a study in central Illinois by Reller (1972). These authors and Kilham (1958 and 1961) also discuss vocalization of the species.

Adult red-bellies separate after the breeding season, but remain somewhat territorial and often occupy areas different from the nesting territory (Weise 1951; Stickel 1965). In southern Illinois pairs may be formed as early as January or as late as late April. In central Illinois courtship activity involving aggregations of up to five birds and much calling and chasing has been noted in the last half of February and early March, and breeding territories appeared to be established by the last of March (Allison 1947; Fawver 1947*a*).

Pair formation centered about the selection and excavation of the nest cavity, in which the male took the lead (Stickel 1965). At Carbondale the excavation of cavities began in January and continued, off and on, into April. In Piatt County Fawver (1947*a*) observed the work of excavation during the first 3 weeks of April. The sizes of nest cavities of red-bellied woodpeckers have not been recorded in Illinois.

Bent (1939) gives egg dates for the red-belly in Illinois from 1 April to 3 June (locality unspecified). In central Illinois egg laying occurs from at least 9 April through 23 June (Fig. 18). No nest is constructed within the cavity, the immaculate white eggs being laid, one per day on consecutive days, on the floor of the cavity. The red-belly, in contrast to the flicker, is a determinant layer (Stickel 1965). Clutch-size data representing 16 nests, mainly from old literature and museum records, showed this distribution: five eggs, 10 nests; four eggs, 4 nests; three eggs, 2 nests.

Stickel (1965) observed that incubation started with the third egg laid, and required 11–12 days. In case of nest failure, a second clutch was laid within 12 days, usually in a different cavity. Nestling life lasted at least 22 days, and as long as 27 days, but usually 26 days. Both sexes shared in the incubation and care of the young but with considerable variation from pair to pair. At night the male usually incubated or guarded the nest (Stickel 1965). Exclusive of cavity excavation, the cycle required about 41 days, assuming the onset of incubation with the third egg, as observed by Stickel (1965). The food of the nestlings was not specifically determined but included both insects and fruit. At the Carbondale study area Stickel (1965) observed the adults bringing food to nestlings in different nests at average rates varying from as few as four trips between 1 p.m. and 2 p.m. to as many as 16 trips per hour around 9 a.m.–10 a.m. The work of feeding was shared about equally by the adults.

Quantitative data on nesting success have not been recorded for any Illinois population of red-bellies. At one nest Stickel (1962) found a large black rat snake *(Elaphe obsoleta)* which had eaten nestlings and an unhatched egg.

Fledglings at Carbondale remained near the nest (within 100 feet) for at least 2 days, after which they began to follow the parents. Juveniles appeared to be independent about 6 weeks after fledging, when they apparently left the area (Stickel 1965). Intensive study of this species in Maryland by Kilham (1961) revealed no evidence of double broodedness, and single broods are probably the rule in Illinois also.

Like other woodpeckers, red-bellies roost singly in cavities, except for new fledglings, which roost in the open and must learn the adult behavior. Again, Stickel (1964) has provided most of the Illinois data on the subject. He observed that, though there is a

surplus of cavities from the nesting season, both sexes excavate additional cavities at other seasons. Such roosting cavities are shallower than nest cavities. Nest chambers were also used for roosting, particularly by males. Birds change roosting cavities often and sometimes return to a formerly used cavity.

Competition for cavities in the nesting season has not been considered a critical problem for the red-belly in Illinois. Reller (1972) pointed out that differences in nest-site selection have reduced competition between red-heads and red-bellies. In the south Stickel (1963) witnessed strife at a nest tree between aggressive hairy woodpeckers and a pair of red-bellies, which remained relatively passive toward the hairies but vigorously attacked a flying squirrel in the same tree. Stickel (1963) also observed aggression of red-bellies toward flickers at both nesting and roosting cavities. In a screech owl nesting and roosting box in Pope County, we found numerous feathers of red-bellied woodpeckers, apparent victims of the owl. Brown & Bellrose (1943) also recorded such predation.

Fall Populations

After the breeding season, strife between red-bellied and red-headed woodpeckers increases considerably, as red-heads turn from more intraspecific aggression to interspecific aggression directed especially toward red-bellies (Reller 1972). Food is a probable source of contention, as both species store mast. In such encounters the red-head is almost always dominant (Ridgway 1889; Schafer 1918; Reller 1972).

Beginning in late September, red-bellies, which have been rather strictly forest birds during the nesting season, expand their occupancy to other, more open, habitats. Whether this change is a movement of immatures, adults, or both is unknown. Nor is it known to what extent the ecological shift entails more than just local movement. At least a small part of the movement appears to be migratory. We have seen a few red-bellies flying with other diurnal migrants along the Mississippi and Ohio valleys on just three mornings between 30 September and 26 October (Fig. 18). The flight pattern and (appropriate southward) direction were the same as those of blue jays, red-heads, flickers, and other species that regularly migrate along these routes in fall. As we have never seen more than four red-bellies per hour on these routes, these migrations cannot account for a sizeable population shift by the species. A red-bellied woodpecker killed on a television tower near Meredosia, Illinois, and found with over 100 specimens of night migrants on the morning of 27 September 1972 (H. David Bohlen, personal communication) is the only indication we have of night migration by the species. Stoddard & Norris (1967) also reported a red-belly killed at a television tower (in Florida), but they did not believe the incident represented night migration.

In contrast to the spring populations of red-bellies, fall populations show pronounced peaks (Fig. 18), reflecting that the population is near its annual high and that the species is increasingly conspicuous as part of the population moves to more open habitats.

Our daily counts of birds in spring (March–May, inclusive) and fall (August–October) showed a ratio of 1.0 red-belly in spring to 2.1 in fall for the state as a whole, with very little difference in the ratios from region to region. There are no data on fall age ratios for the red-belly, as there are for the red-head, with which to interpret the spring-fall ratios. The fall-spring ratio for the red-belly is higher than that of any other woodpecker in Illinois.

Winter Populations

The distribution of winter records for the red-bellied woodpecker in Illinois is shown in Fig. 20. The species probably occurs in every county in winter, but published records are still lacking for several.

The fall dispersal of red-bellies that takes the birds into habitats not generally occupied in summer may also involve some extensive geographic displacement, i.e., more than the migration that has been observed. Kumlien & Hollister (1951) noted that in 1903 red-bellies appeared to be more common in winter than in summer near the northern edge of the species' range. Similarly, Beal (1911) in central Iowa found red-bellies "abundant" in winter every year, though he "never" saw one in the breeding season! We have noted the same same phenomenon—red-bellies apparently increasing disproportionately northward in winter. Alfred Gross made the cross-country censuses of 1907–1909, and we made them in 1957–1958, and in neither case were red-bellied woodpeckers detected within the northern Illinois census transects in summer. In winter, however, red-bellies came within the northern transects in both series of censuses (Tables 7 and 8). The density of the winter population of red-bellies increased greatly in the north between 1907 (1 bird per 100 acres in forest) and 1957–1958 (9.5 per 100 acres). The cumulative Christmas counts of red-bellies (Fig. 21) also show notable upward surges in northern Illinois, 1915–1925 and 1954–1959, and in central Illinois, 1919–1939 and 1954–1959, while the southern Illinois counts have remained relatively stable. Recent (1965–1975) annual variation in the Christmas counts has ranged from about 2 percent to 46 percent per year and averaged 20–21 percent in northern and southern Illinois but only 8 percent in the central region. On the long-term average, it took 3.6 party hours to find a red-belly on the northern Christmas counts, 1.2 hours on the central counts, and 1.0 hour on the southern counts.

The population dynamics of the red-bellied wood-

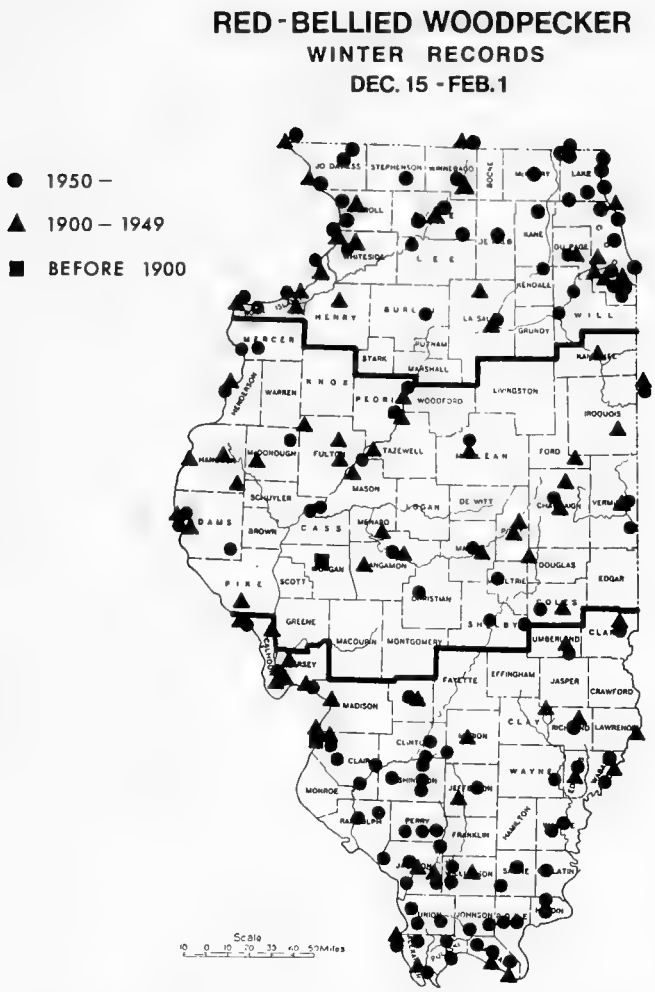

Fig. 20.—Distribution of winter records of the red-bellied woodpecker in Illinois. Heavy horizontal lines separate the three regions of the state (north, central, and south) referred to in the text.

pecker in Illinois are puzzling. From population density figures and habitat acreage figures, we estimated the June population of red-bellies in the state to be about 190,000 adult birds in 1957–1958, with about 150,000 in the southern region, 40,000 in the central region, and an almost negligible population (under 2,500) in northern Illinois. In winter (January) the state population jumped to about 515,000 (2.7 times the June number), with about 360,000 in southern Illinois (2.4 times the June number), 99,000 in central Illinois (2.5 times the June number), and an incredible 55,000 in northern Illinois (22.0 times the population of June). In more recent censuses in southern Illinois (1973–1975), the number of winter red-bellied woodpeckers was 2–3 times that found in summer in the same woodlands. To some extent the increase in winter reflects the increased conspicuousness of red-bellies in open field habitats and in forests with the foliage gone, but there is no reason to believe that conspicuousness is increased more in northern Illinois than in the other regions. The winter data for central and southern Illinois do not indicate any major exodus of red-bellies. Better population data are needed for both summer and winter populations, especially in the north, to answer at least these questions: (1) Is the great increase in numbers of red-bellies in winter real? (2) If so, why are the increases not comparable in central and northern Illinois? (3) Where does the excess winter population in the north come from?

Although the red-belly expands its occupancy of habitats in winter, forest remains an important habitat (Table 8). Winter population densities of red-bellies were higher in bottomland than in upland forest, as they were in summer (Tables 7 and 8). In southern Illinois Ferry (1907*a*) observed that red-bellies favored tall softwood trees of the river bottoms, where there was a large proportion of decayed tree trunks.

In five upland woods in southern Illinois in the winters of 1973–1975 we found positive correlations between the densities of red-belly populations and the Importance (Y) of hackberry, the Importance of ash, and high basal area, particularly of large trees. For hackberry the correlation was 0.906 ($P = < 0.02$); for ash, 0.969 ($P = < 0.01$); for total basal area, 0.866 ($P = < 0.05$); and for the ratio of the basal area of large trees to total basal area, 0.972 ($P = < 0.01$). There was a negative correlation between the numbers of red-bellied woodpeckers and the Importance of oaks ($r = -0.810$, $P = 0.05$) and of hickories ($r = -0.876$, $P = < 0.05$).

In eight bottomland woods in southern Illinois in the winter there was some correlation between red-

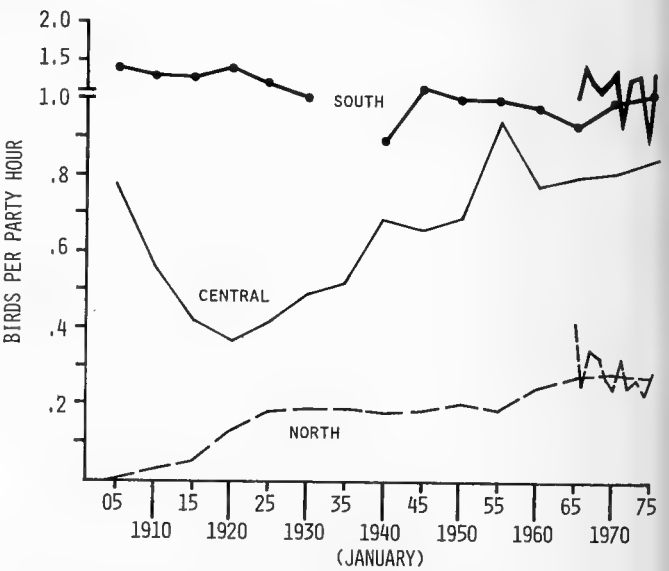

Fig. 21.—Red-bellied woodpeckers seen per party hour on Audubon Christmas counts in the three regions of Illinois. Each point represents a 5-year average except that annual variation is shown between 1965 and 1975 for the north and south regions.

TABLE 8.—Winter populations of red-bellied woodpeckers in various Illinois habitats.

Habitat	Acres	Birds per 100 Acres	Years (January)	Type of Census	Region or County	Reference
Suburban woodlot	20	(+) [a]–10 (avg 5.0)	1968–1972	Map	Lake (N) [b]	Miller & Miller 1970, 1972
Urban residential	164	0.6	1976	Strip	North	This paper
Urban residential	191	0	1976	Strip	Central	This paper
Urban residential	191	5	1976	Strip	South	This paper
Oak-maple forest	55	0–16 (avg 5.5)	1925–1975	Map	Champaign (C)	Kendeigh 1944; Kendeigh et al. 1957
Oak-maple forest	55	0–4 (avg 1.5)	1925–1936	Map	Champaign (C)	Kendeigh 1944
Oak-maple forest	55	2–5 (avg 4.4)	1938–1949	Map	Champaign (C)	Kendeigh 1944, 1948*a*, 1949
Oak-maple forest	55	2–16 (avg 7.4)	1950–1975	Map	Champaign (C)	Kendeigh et al. 1951, 1957
Grazed bottomland woods	53	4–11 (avg 7.5)	1955, 1957	Map	Macon (C)	Chaniot & Kirby 1955*a*; Kirby & Chaniot 1957
Bottomland forest	50	(+)	1951	Map	Cook (N)	Montague 1951
Mature bottomland forest	1,398	0–25 (avg 9.6)	1974–1976	Strip	South	This paper
Mature upland forest	772	1–17 (avg 6.3)	1974–1976	Strip	South	This paper
Forest (all types, including edge)	46	4–9 (avg 6.5)	1940–1941	Map	Piatt (C)	Johnston 1942
Forest (all types, including edge)	65	1	1907	Strip	North	Graber & Graber 1963
Forest (all types, including edge)	45	4–15 (avg 9.5)	1957–1958	Strip	North	Graber & Graber 1963
Forest (all types, including edge)	50	2	1907	Strip	Central	Graber & Graber 1963
Forest (all types, including edge)	152	4–10 (avg 7.9)	1957–1958	Strip	Central	Graber & Graber 1963
Forest (all types, including edge)	241	5	1907	Strip	South	Graber & Graber 1963
Forest (all types, including edge)	211	7–12 (avg 9.5)	1957–1958	Strip	South	Graber & Graber 1963
Shrub habitat, including edge shrub	74	2–9 (avg 5.4)	1957–1958	Strip	Central	Graber & Graber 1963
Shrub habitat, including edge shrub	33	3	1907	Strip	South	Graber & Graber 1963
Shrub habitat, including edge shrub	101	15–18 (avg 16.8)	1957–1958	Strip	South	Graber & Graber 1963
Shrubby field and forest edge	85	(+)–1	1955–1956	Map	Richland (S)	Shaw & Stine 1955; Shaw et al. 1956
Shrubby field	40	(+)–10 (avg 4.4)	1958–1965, 1968	Map	Lawrence (S)	Scherer & Shaw 1960; Shaw et al. 1968
Pasture	440	0	1907	Strip	North	Graber & Graber 1963
Pasture	83	1	1957	Strip	North	Graber & Graber 1963
Pasture	343	2	1907	Strip	Central	Graber & Graber 1963
Pasture	156	0–2 (avg 1.3)	1957–1958	Strip	Central	Graber & Graber 1963
Pasture	208	1	1907	Strip	South	Graber & Graber 1963
Pasture	93	0	1957–1958	Strip	South	Graber & Graber 1963
Fallow fields	114	1	1907	Strip	South	Graber & Graber 1963
Fallow fields	103	2	1957–1958	Strip	South	Graber & Graber 1963
Cornfields	60	3	1907	Strip	South	Graber & Graber 1963
Cornfields	277	1	1957–1958	Strip	South	Graber & Graber 1963

[a] The plus symbol (+) indicates fewer than one bird per 100 acres.
[b] N refers to the northern region of Illinois, C to the central, and S to the southern region, as shown on winter distribution maps, e.g., Fig. 5.

bellied woodpecker numbers and the Importance of hackberry ($r = 0.730$, $P = < 0.05$). Likewise, there was some correlation between the density of red-bellied woodpeckers and the basal area ratio (basal area of large trees to total basal area) ($r = 0.701$, $P = < 0.05$). In the bottomland forest interior, red-bellies apparently seek the larger trees, especially maples and hackberries. The species can thus to some extent avoid the red-headed woodpecker, which predominates in the oaks in the bottoms. The presence of over 35 red-heads per 100 acres in bottomland woods seems to depress the red-bellied woodpecker population (Fig. 22). In four bottomland woods with over 35 red-heads per 100 acres, the red-bellied population was 3.5–5.5 birds per 100 acres. In four bottomland woods with red-headed woodpecker numbers of less than 35 per 100 acres, the red-bellied woodpecker population was 17.5–18 birds per 100 acres. In all

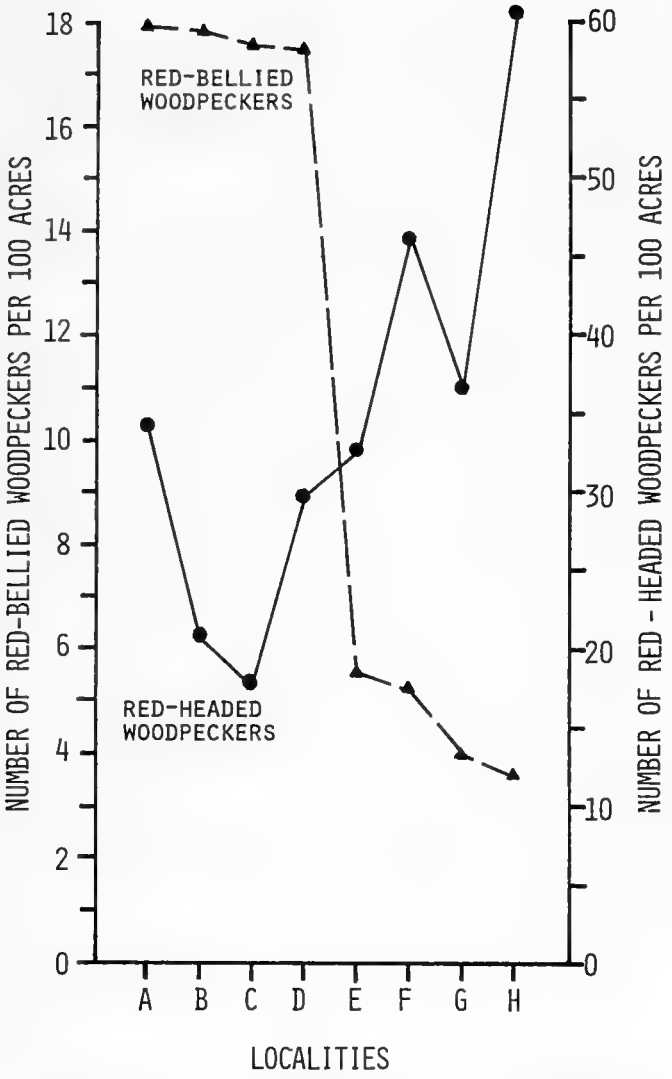

Fig. 22.—Inverse relationship between winter populations of red-headed and red-bellied woodpeckers. Points on the dash line represent numbers of red-bellied woodpeckers in eight bottomland woods in southern Illinois, identified in the introduction. Points on the solid line represent numbers of red-headed woodpeckers in the same woods.

eight woodlands there was a negative correlation ($r = -0.556$, $P = > 0.10$) between average populations of these two species for 3 years. In individual woodlands the negative correlation between these two populations in the 3 years was -0.781 ($P = > 0.10$); -0.843 ($P = > 0.10$); -0.916 ($P = < 0.10$); -0.987 ($P = < 0.02$); -1.00 ($P = < 0.001$). In two woodlands there was no correlation and in one there was a positive correlation (0.991, $P = < 0.01$). The very large old trees and the generic composition (many maples and hackberries) may have allowed this latter woodland to support high populations of both species (2-year average: 34 red-heads and 18 red-bellies per 100 acres).

Red-bellies are generally tree gleaners (Reller 1972), foraging on trunks and limbs of trees, and their presence in such open-field habitats as cornfields, fallow fields, and pastures in winter (Table 8) indicates some ground or near-the-ground foraging not mentioned in the Illinois literature.

Food Habits

Beal (1911), referring not specifically to Illinois, found the red-bellied woodpecker's food during the year to be about 31 percent animal matter and 69 percent vegetable. Of all food types, mast (acorns, beechnuts, hazelnuts, and pecans) was most important, constituting about 31 percent of all food and a much larger portion (67 percent in November) in fall and winter. We have seen red-bellies working on pecans in late September in the Mississippi Valley of Union County. Fruit, especially wild fruit, was also important throughout the year, but varied from a low in April (7.5 percent of the diet) to a high in August (64 percent).

Of animal food, beetles, most notably weevils and wood-boring species, were a consistent part of the diet, as were ants. Orthopterans—grasshoppers, crickets, and egg cases of cockroaches—were important throughout the year, though more so in summer.

There are few specific Illinois observations on the food. Ridgway (1889) believed the red-belly to be a pest in orchards because of its fondness for apples. Red-bellies eat corn, but not in economically significant amounts. Red-bellies have been observed feeding on chokecherries in southern Illinois (Ferry 1907*b*) and sassafras fruit in central Illinois (Allison 1947). The red-belly is also well known at feeders, taking suet, cheese, and grain, including sunflower seeds (Vredenburgh 1905; Schafer 1918; Cone 1956). Southern (1966) observed red-bellies feeding on dead gizzard shads in winter in northwestern Illinois.

Longevity

There are, to our knowledge, only two longevity records for the red-bellied woodpecker in Illinois, both around 5–6 years. A bird banded in 1966 south of McLeansboro, Illinois, was found dead 5 years and 8 months later in the same locality (computer printout from U.S. Fish and Wildlife Service Bird Banding Office 1972). Another bird banded in 1924 at Kansas, Illinois, was retrapped in the same place nearly 5 years later (Cooke 1937).

Specimen Data

Red-bellied woodpecker specimens from Illinois, of which we have examined 49 (28 males, 21 females), are for the most part separable from comparably plumaged specimens of the nominate race from South Carolina and Georgia, which have a darker appearance, especially on the back and rump. We consider all the Illinois specimens to represent *Centurus carolinus zebra* though there is great variation in back

TABLE 9.—Measurements of Illinois specimens of red-bellied woodpeckers, excluding obviously worn, molting, and juvenile specimens.

Region of Illinois	Months	Number of Specimens	Sex	Wing (Chord) in mm			Tail Length in mm			Culmen (from Naris) in mm		
				Range	Mean	SD	Range	Mean	SD	Range	Mean	SD
North and Central	Dec.–Feb.	6	M	126–133	130.1	2.62	76–85	79.1	3.12	...	...	...
South	Dec.–Jan.	8	M	125–134	130.5	3.20	76–83	79.6	2.62	...	...	...
State	Mar–Apr. Oct.–Feb.	25	M	125–134	130.2	2.66	75–85	79.4	2.65	24–28[a]	25.8	1.11
State	Oct.–Mar.	20	F	121–134	127.5	3.05	75–86	78.5	3.54	23–25[a]	24.3	0.95

[a] Culmen measurements from only seven males and seven females.

color (black-to-white ratio), with about one-fourth of them showing coloration somewhat intermediate toward *C. c. carolinus*. There was no consistent color or size difference between specimens from northern and central Illinois and those from southern Illinois (Table 9). Females averaged slightly smaller than males in all measurements.

Weights of males from northern and central Illinois were 74.3 and 80.6 grams for April specimens, 83.6 for a February specimen, and 91.8 for a November specimen. Weights of female specimens from central Illinois were 78.6 grams (February specimen), and 73.9 and 74.2 grams (November specimens).

RED-HEADED WOODPECKER
(Melanerpes erythrocephalus)

(Fig. 23, 24, and 25)

Spring Migration

The impressive diurnal migrations of red-headed woodpeckers often seen in Illinois in fall have apparently never been recorded in spring. Most of the spring migration may be nocturnal. We have heard red-headed woodpeckers calling at night relatively rarely compared with the frequency with which we have heard the flicker. In east-central Illinois we have heard what we believed to be red-heads in migration on nights between 24 April and 7 May between 8:50 p.m. and 3:20 a.m. CST. Musselman's (1931) statement that red-heads "appeared over night" on 15 April 1930 also suggests night migration.

Because red-heads winter in some years in all parts of the state, the onset of spring migration is often obscured by the presence of wintering birds. Published spring arrival dates for the state range from mid-February (Beal 1886; Strode 1892; Gault 1901; Musselman 1932) to early May (Walter & Walter 1904). Red-head populations exhibit great annual variation in behavior, and this range of arrival dates is probably truly representative of the species, depending upon the year cited. The range of arrival dates is so variable that the spring migration of red-heads is not predictable with any accuracy in contrast to those of most migrant species.

The arrival dates most frequently cited in the Illinois literature fall in the period 23–30 April with no consistent difference between regions. There are also indications of migration waves in the periods 1–10 and 20–30 March and 5–15 April.

Our counts (Fig. 26) showed notable population changes in late March and early April in southern and central Illinois, and in late April and early May in central and northern Illinois. High spring populations came 7–23 April in southern Illinois, 29 April–7 May in central Illinois, and 9–13 May in northern Illinois (Fig. 26). Cooke (1943) reported on a bird banded in Highland Park on 20 May 1940, which was captured alive at Estelline, South Dakota, about 3 weeks later on 10 June—seemingly a very late migrant.

Distribution

The red-headed woodpecker is a species mainly of the eastern and central United States (Fig. 25). In Illinois red-heads probably nest in every county, though the breeding distribution is still incompletely known (Fig. 27).

Nesting Habitats and Populations

In the breeding season, the red-headed woodpecker is a savannah or forest-edge species with generally low populations in forests (Table 10, disregarding samples under 30 acres) unless the forests become opened up by some such calamity as fire, disease, or wind damage. Thus, Butler (1897) pointed out that red-head populations become very high at times of "deadenings," i.e., when trees are killed in epidemic proportions. Similarly, Yeager's (1949) study of flooded bottomlands showed that as flooding killed large numbers of trees, the woodpecker population—particularly the red-head population—surged upward. Musselman (1930) observed that red-heads were attracted to an area of fire-killed oaks. The relationships between red-head populations and dead trees is shown by the studies of Kendeigh and his students on Trelease Woods (Champaign County), where red-head numbers climbed dramatically as American elms (a dominant species) died from elm diseases on a mas-

Fig. 23.—Juvenile red-headed woodpecker at Allerton Park, Piatt County, in October. A gray head and black bars on wings are characteristic of the juvenile plumage.

sive scale and opened up the forest (Kendeigh & Brewer 1956; Kendeigh & Brooks 1963*b*). Dutch elm disease, because of its wide distribution, has almost certainly been responsible for an increase in the state's red-head population in the past 20 years. As natural succession fills in the gaps where large elms fell, the red-head population is likely to decline again.

Red-heads nest in both upland and lowland habitats (Table 10). Our June censuses of 13 woodlands (5 upland, 8 bottomland) in southern Illinois indicate a strong preference by red-heads for bottomland woods in that region. In only one upland woods were any red-heads seen, and this particular upland woods adjoined a bottomland that had a high breeding population (over six birds per 100 acres).

Age of stand, basal area or density of all trees or any size class of trees, diversity, Importance of any species or genus (or any size class thereof) in the eight bottomland woods analyzed vegetatively could not be correlated with numbers of red-headed woodpeckers present in June. Five genera of trees (woody plants over 4 inches DBH) made up 75 percent of the Importance of trees in each of six woodlands having red-heads. These genera were *Quercus* (oaks), *Carya* (hickories), *Celtis* (hackberries), *Ulmus* (elms), and *Acer* (maples). One woodland (E) with a population of two to three birds per 100 acres consisted simply of 75 percent oak, 23 percent hickory, and the remainder ash, elm, and persimmon. The two bottomland woods without red-heads had less than 70 percent (Importance) of the five genera of trees mentioned above, and less than 45 percent of their compo-

Fig. 24.—Adult red-headed woodpecker with food for its young at its nest hole 11 miles east of Havana, Mason County, Illinois, in early July.

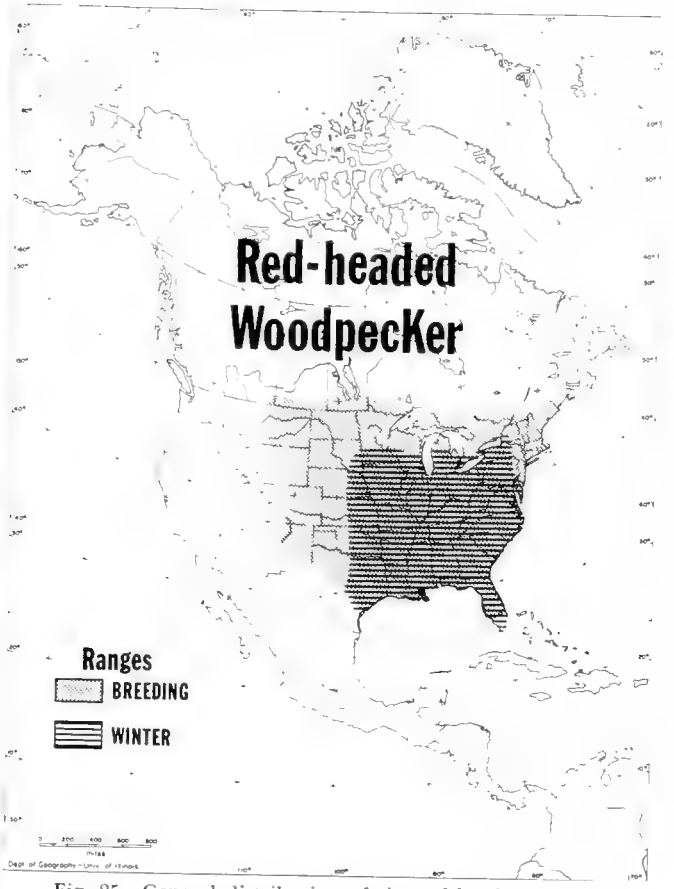

Fig. 25.—General distribution of the red-headed woodpecker. The range shown here may include large sections in which there are few, if any, red-headed woodpeckers because of the nature of the terrain and lack of suitable habitat.

sition was oak-hickory-hackberry-elm. The amount of forest edge and open areas within woods—providing in effect forest edge—are probably important to the red-head. In the eight bottomland woods studied, the highest populations (9–12 birds per 100 acres, 2-year average) occurred in woods that had a large amount of edge and internal openings either from fallen trees or because of the presence of streams and oxbows within them. The simple (in diversity) woodland (E) mentioned above had many irregular open areas within it because of a fire that had occurred some 10 years earlier. Williams (1975) found that red-headed woodpeckers in a central Illinois woodland spent most of their time foraging in oaks and dead trees in open areas in the woodland.

Red-headed woodpeckers are tolerant of humans. Ridgway (1887) considered the red-head by far the most numerous breeding woodpecker in the city of Mt. Carmel, and there are many old nest records for the species in cities throughout the state. More recently, however, urban populations of red-heads have been poor. The strip-censuses of 1957–1958 showed breeding populations of only two birds per 100 acres in southern Illinois towns (Table 10), while numbers

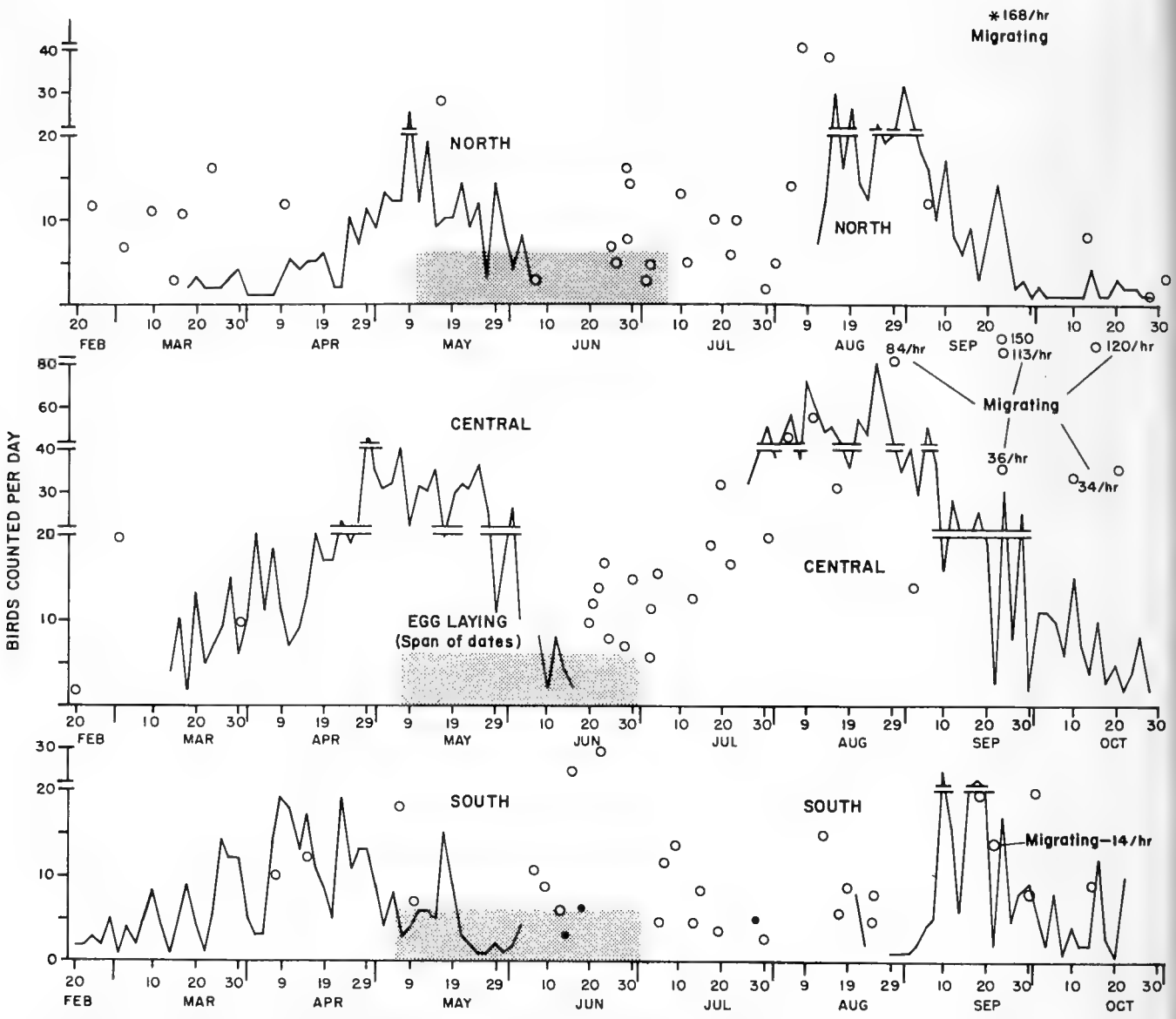

Fig. 26.—Egg-laying and migration seasons of the red-headed woodpecker in different regions of Illinois. Spring and fall graph lines show the higher daily count of each 4 days (1967–1970). Hollow circles represent counts made in other years or by other observers. Dark dots (southern region) represent isolated counts made in 1967. Shaded areas show the span of dates during which egg laying has been recorded.

in central and northern Illinois cities were too low to detect in our samples. In urban areas red-heads are in the starling's stronghold and often fail in competition with that species (Moseley 1947; Polder 1963).

As red-heads nest in shrub areas (Table 10) and other woody habitats more open than forest, the significance of dead trees to this bird may be primarily related to increased sunlight or visibility in the habitat. Nest sites of red-heads are often in dead trees. Published nest-site data for 47 red-head nests in northern and central Illinois showed about 80 percent to be in dead trees, usually in the trunks. Some of the nests reported in live trees may have been in dead branches. Of 33 nests for which we have data, 45 percent were in elms and 24 percent were in oaks.

From dead tree to utility pole would seem but a small change. W. S. Brenneman (personal communication) of the Illinois Power Company has studied woodpecker damage to utility poles and found the red-head to be the species by far most often involved in such damage.

Nest heights varied from 4 to 40 feet, with no significant mode, and averaged about 20 feet. In Champaign and Piatt counties, Reller (1972) noted that red-head nests faced predominantly south and west.

Reller (1972) also observed that in summer red-heads foraged to a large extent on the ground. The statewide strip censuses of 1907–1909 and 1957–1958 showed that red-heads were often found in grasslands

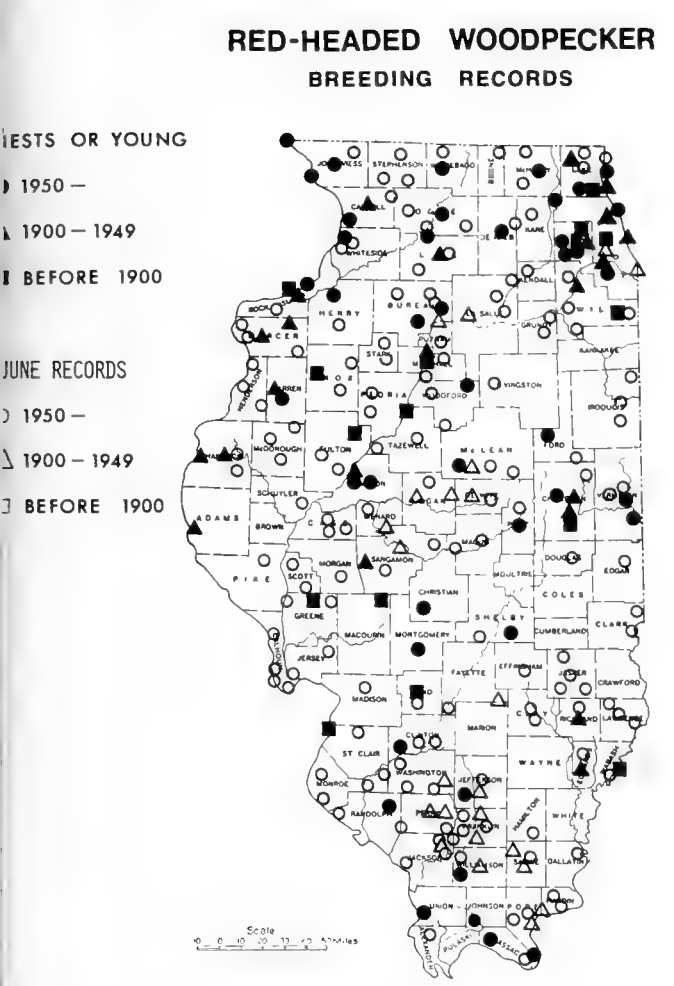

Fig. 27.—Distribution of breeding records of the red-headed woodpecker in Illinois. Hollow symbols represent birds seen or heard in June.

of all types in densities high enough (three to four per 100 acres) to indicate that this is an important foraging habitat for the species.

The population trend for the red-headed woodpecker since the turn of the century had been downward until recent years. We estimated the June population of breeding adults in Illinois to be about 1,270,000 in 1909 and only 115,000–134,000 in 1957–1958 (Graber & Graber 1963). Since then, coinciding with the great die-off of elms in the state's forests, red-head numbers have increased, but the level of the present state population is unknown. Our census figures for some southern forest areas (Table 10) provide an indication of the increase. In 1957–1958 red-heads were not detected in the forest transects, but in 1974 we recorded an average density of three birds per 100 acres in mature bottomland forest and of four birds per 100 acres in 1975.

The causes of the decline in the red-headed woodpecker population before the elm epidemic can only be surmised. White settlement of Illinois in the 18th and 19th centuries greatly reduced forest acreage but increased edge habitats that favored red-heads.

Since about 1920 habitats have changed increasingly to block forms while edge habitats have declined (Graber & Graber 1963). The two woodpecker species (red-head and flicker) that particularly occupied the edge underwent about the same decline (roughly 90 percent) between 1907 and 1957. A second factor that affected both species adversely in this period was the starling with its incredible population increase in the 20th century and its ability to compete with native species, particularly in managed habitats. The recent decline in the red-headed woodpecker's populations apparently ended when the elm epidemics created much new natural habitat. In recent years large reservoir construction has flooded extensive areas of lowland forest, killing the trees and creating more habitat for red-heads. The durability of this habitat is probably relatively short. Yeager's (1949) data show about one-fourth of the trees down in 8 years from the onset of flooding.

Eifrig (1937 and 1938) stated that red-head numbers were declining because of the automobile. He observed that red-heads were sometimes hit by cars as the birds picked up insects from the road. Red-heads do appear to show special susceptibility to this type of mortality (Flint 1926 and 1934–1935; Blocher 1927; Komarek & Wright 1929; Starrett 1938).

Few Illinois species seem as argumentative as the red-head. Much of the time they appear to be bickering among themselves or with other species. This intra- and interspecific aggression is exhibited both in and out of the breeding season (Cooke 1916; Schafer 1917; Ridgway 1920; Cone 1956; Willson 1970; Reller 1972). Hess (1910) suspected an inverse relationship between red-head and flicker populations in central Illinois, and in southern Illinois Bush (1934–1935) detected an inverse relationship between red-head and red-bellied woodpecker populations in winter. Reller (1972), Willson (1970), and Schafer (1917) observed that aggression was particularly keen between red-heads and red-bellied woodpeckers. Red-head strife has also extended to flickers, pileateds, downies, and other woodpeckers, starlings, brown creepers, house wrens, white-breasted nuthatches, blue jays, house sparrows, squirrels, and other species (E. E. 1885; Cooke 1885*b* and 1916; Butcher 1896; Field 1917; Moseley 1917; Ridgway 1920; Reller 1972; Moseley 1947). Red-heads also have a bad reputation for attacking other birds' nests, breaking and sometimes eating eggs (and even killing fledglings), mainly of cavity-nesters, e.g., chickadees, bluebirds, cliff swallows, and wood ducks, but also even of domestic chickens and of wood pewees (Willard 1896; Schafer 1920 and 1923; Frank Bellrose personal communication).

Nesting Cycle

A number of banding records indicate homing in Illinois red-head populations, and summer-banded

TABLE 10.—Breeding populations of red-headed woodpeckers in various Illinois habitats.

Habitat	Acres	Birds per 100 Acres[a]	Years	Type of Census	Region or County	Reference
Suburban residential	8	25	1916	Nest	Richland (S) [b]	Cooke 1916
Urban residential	235	0	1958	Strip	North & Central	Graber & Graber 1963
Urban residential	98	2	1958	Strip	South	Graber & Graber 1963
Modified woodland (human housing)	28	14	1937	Nest	Lake (N)	Beecher 1942
Unmodified woodland	27	15	1937	Nest	Lake (N)	Beecher 1942
Oak-maple forest	55	0–18 (avg 6.0)	1927–1943	Map	Champaign (C)	Kendeigh 1944
Oak-maple forest	64	3	1947	Map	Champaign (C)	Johnston 1947
Oak-maple forest edge	1.25 miles[c]	0–46 (avg 13.7) [c]	1944–1975	Map	Champaign (C)	Kendeigh 1948*b*; Kendeigh & Brooks 1965*b*
Forest (all types, including edge)	177	1–6 (avg 4.0)	1957–1958	Strip	North	Graber & Graber 1963
Forest (all types, including edge)	214	3–6 (avg 4.7)	1957–1958	Strip	Central	Graber & Graber 1963
Forest (all types, including edge)	60	5–13 (avg 10.0)	1907, 1909	Strip	South	Graber & Graber 1963
Forest (all types, including edge)	340	0	1957–1958	Strip	South	Graber & Graber 1963
Grazed bottomland woods	53	4	1955	Map	Macon (C)	Chaniot & Kirby 1955*b*
Mature bottomland forest	1,077	0–18 (avg 3.4)	1973–1975	Strip	South	This paper
Mature upland forest	479	0–1 (avg 0.4)	1974–1975	Strip	South	This paper
Upland second-growth oak-hickory	56	4–11 (avg 5.9)	1941–1942, 1944	Map	Sangamon (C)	Robertson 1941*b*, 1942*b*, 1944*b*
Second-growth hardwoods	15	27	1937–1938	Map	Rock Island (N)	Fawks 1937, 1938
Woods (unspecified)	20	10–20 (avg 16.7)	1914–1916	Nest	Rock Island (N)	J. J. Schafer (unpublished notes 1914–1923)
Woods (unspecified)	54	7–23 (avg 16.3)	1917–1923	Nest	Rock Island (N)	J. J. Schafer (unpublished notes 1914–1923)
Savannah	23	18	1957–1958	Strip	North & Central	This paper
Orchard	45	4–5 (avg 4.4)	1907, 1909	Strip	South	Graber & Graber 1963
Orchard	78	0	1957–1958	Strip	South	Graber & Graber 1963
Late shrub	21	10	1966	Map	Vermilion (C)	Karr 1968
Shrub area	50	3–7 (avg 4.0)	1957–1958	Strip	Central	Graber & Graber 1963
Shrub area	56	28	1907, 1909	Strip	South	Graber & Graber 1963
Shrub area	129	0	1957–1958	Strip	South	Graber & Graber 1963
Swampy prairie	64–67	9–19 (avg 14.3)	1941–1942, 1944	Map	Sangamon (C)	Robertson 1941*a*, 1942*a*, 1944*a*
Pasture	193	3	1909	Strip	North	Graber & Graber 1963
Pasture	279	0–1 (avg 0.4)	1957–1958	Strip	North	Graber & Graber 1963
Pasture	441	4–7 (avg 5.9)	1907, 1909	Strip	Central	Graber & Graber 1963
Pasture	171	0	1957–1958	Strip	Central	Graber & Graber 1963
Pasture	882	2–4 (avg 2.6)	1907, 1909	Strip	South	Graber & Graber 1963
Pasture	120	0	1957–1958	Strip	South	Graber & Graber 1963

[a] All figures were converted to birds per 100 acres (territorial males or nests × 2).
[b] S refers to the southern region of Illinois, C to the central, and N to the northern region, as shown on the winter distribution maps, e.g., Fig. 5.
[c] These entries are miles of forest edge and birds per mile of edge.

birds—presumably local breeders—have returned as early as 17 April (Lincoln 1927).

Little has been recorded on the red-head's nesting cycle in Illinois, and virtually nothing on its nesting in the southern region. In northern Illinois Gault (unpublished notes 1889) observed nest excavation in progress on 25 April, and in central Illinois Musselman (1937) observed mating of red-heads on 5 May.

As is typical of woodpeckers, no nest is constructed, and the white eggs are merely laid on the floor of the cavity, often on wood chips from the excavation. Polder (1963) observed the excavation of a nest cavity in 2 days by a pair of red-heads. Sizes of natural cavities used as red-head nests have not been measured in Illinois. Ford (1939) gave these nest-box dimensions for this species: floor, 6 × 6 inches; depth, 12–15 inches; height of entrance above floor, 9–12 inches; diameter of hole, 2 inches. Gault (unpublished notes 1877) measured one cavity that was 9 inches deep. Red-heads have used nest boxes in Illi-

nois, and Musselman (1934 and 1935) recorded about a 5 percent frequency of occupation of bluebird boxes by red-heads. Frank Bellrose and Robert Crompton (personal communication) have never found red-headed woodpeckers nesting in wood duck boxes though flickers commonly do so.

Egg laying begins at least as early as 6 May in southern Illinois, 7 May in central Illinois, and 11 May in northern Illinois, and occurs at least as late as 7 July in the north (Fig. 26). Laying, especially in the south, probably begins earlier than present records show. Data on clutch sizes are mainly from old literature or old museum records. The average of 30 clutches from northern and central Illinois was 4.7 eggs, with the frequency distribution being: 6 eggs, 21 percent; 5 eggs, 43 percent; 4 eggs, 27 percent; and 3 eggs, 10 percent.

Neither the incubation period nor the duration of nestling life have been measured in any Illinois population of red-heads. Observations by Kyler (1927) indicate that nestling life may exceed 3 weeks, but it has not been precisely measured.

There are no measurements of nesting success for any Illinois population of red-heads. The earliest we have seen young out of the nest was 18 June in the south and 7 July in central Illinois, where fledglings are frequently observed in the 2nd week of July.

Red-headed woodpeckers sometimes raise two broods. Reller (1972) observed that at least 3 pairs, of 15 under observation in central Illinois, nested a second time while still caring for the first broods fledged.

Age Ratios

The distinctive and relatively long-lived juvenile plumage of the red-headed woodpecker (Fig. 23) provides a potentially useful indicator of productivity in this species. Kyler (1927) hand reared three young red-heads and found that red began to appear on their heads about 10 weeks after hatching. During our censuses, when we were able to see red-heads clearly enough to age them, we recorded adults and juveniles, or immatures, separately. The ratios of the two age groups are shown in Table 11. As the first birds fledged in June and July, the proportion of young was naturally low—only 8 percent by 20 July in west-central Illinois. There was a consistent, progressive increase in the percentage of young from summer into fall (Table 11). We observed a ratio of 0.9 young per adult among red-heads migrating along the Mississippi River in a large migration of these birds on 21 September.

Note also (Table 11) that while the percentage of young increases later in the season, the total number of birds seen declines, suggesting that adults tend to precede the young in migration. Nelson (1876–1877) believed that it was young birds which tended to winter in Illinois. We have often seen immatures, with dark or partly dark heads and juvenile wing patterns, in January, but we have seen only one bird with that combination of characters as late as 9 April. Immatures with partly red heads are seen commonly in early September.

Fall Migration

The diurnal migration of red-headed woodpeckers in Illinois is sometimes conspicuous, with 100 or more birds passing a given point in an hour. The birds fly silently, singly, and in loose, somewhat linear groups, generally fewer than 20 birds at a time with 5- to 15-minute gaps between groups. They fly at heights ranging from 50 to 600 feet or more above local terrain. The birds follow essentially the same flight line, passing over or parallel to distinctive topographic features, most notably the scarp of a floodplain. Often up to 15 or more other species are involved in these flights, most often blue jays, whose numbers generally far exceed the numbers of red-heads and other species. Though the migration routes of the red-head and jay do coincide in places, it is not known whether the routes are the same throughout the state. We have seen both species migrating along the Mississippi, Illinois, and Ohio rivers. We have not witnessed such migrations on other waterways, and there are no published observations of the migration elsewhere in the state though it is to be expected on other major streams and perhaps along the Lake Michigan shore. The directions of

TABLE 11.—Age ratios of red-headed woodpeckers in central Illinois (1969) and northern Illinois (1968).

Date	West-Central		East-Central		Northwestern	
	Total Birds Aged	Percent Immature	Total Birds Aged	Percent Immature	Total Birds Aged	Percent Immature
July 11–20	65	8	...	..	...	..
July 21–31	172	30	...	..	...	..
August 1–14	168	54	187	25	...	..
August 15–31	119	50	193	40	202	24
September 1–30	54	61	171	44	150	47
October 1–31	5	..	53	57	8	..
Total	*583*		*604*		*360*	
Mean (after July)		54		38		33

the fall flights are generally downstream, south or west of south, but eastward (Widmann 1907) and southeastward (Cooke 1888) flights have been observed at St. Louis. Weber (1966) witnessed an apparent reverse (northward) fall migration up the Mississippi at Keokuk. We have seen red-heads migrating under both clear and cloudy skies, including overcast, and with southerly and northerly winds and in calms. The relationship (if any) of these flights to frontal weather systems is unknown.

The highest flight density we have recorded was 168 red-heads per hour on 21 September 1968 near Thomson, Illinois, on the Mississippi, but Widmann (1907) counted 284 per hour crossing the Mississippi at St. Louis on 15 September 1884. More frequently we have observed densities of 80–120 red-heads per hour in September and October on the Mississippi and Illinois rivers (Fig. 26). The highest flight density we have seen on the Ohio River was only 14 red-heads per hour. Our observations have all been made from the Illinois side of the rivers. Such migrations occur on both sides as well as over the Mississippi River, but there are no data on where the river migrants originate their flights and little on their seasonal, annual, or geographic variation. We have usually seen the flights between 6:00 and 11:00 a.m. CST, but the large flight seen by Weber was mostly in the afternoon (11:30–4:30 p.m.). These migrations are heaviest in September and October. They begin at least by 28 August (Graber 1962; Nolan 1957*a*) and extend to at least 26 October.

Such migrations occur every year, but not every day of the season. Many days in September and October we have looked for the flights in vain. Although such migrations are impressive, they do not seem to account for even a large part of the massive population shift of red-heads that occurs every year between summer and winter at Illinois latitudes. We have observed what appeared to be long-distance daytime flights of single red-heads across country where there was no obvious association with distinctive topography. The headings were southeast in east-central Illinois and southwest in west-central Illinois. Such flights may merely represent the origins of the flights along the rivers where the birds become concentrated.

Besides these diurnal flights, red-heads also migrate at night, but the relative volume of diurnal versus nocturnal migration is unknown. Ridgway's (1881*a*) father heard red-heads migrating at night over Wabash County in early October 1879. Nearly all of the local population vanished concomitantly with that migration. We have also heard what we believed to be red-heads calling at night, apparently in migration in east-central Illinois on a few nights between 7 September and 22 October between the hours of 8:00 p.m. and 4:00 a.m. CST. The presence of red-heads among the night migrants killed at television towers in Illinois 9–29 September is also indicative of night migration, but the species is relatively rare as a tower casualty—only 5 red-heads among over 12,000 birds identified from tower kills in Illinois.

The ratio between the numbers of birds counted in spring and those counted in fall is particularly interesting for the red-headed woodpecker because of the age-ratio data we have for this species. If the spring population is the adult breeding population and the fall population is the surviving adult population plus the surviving young, then we may expect some consistent relationship between the age ratios and the spring-fall ratios. In northwestern Illinois we saw 1.5 red-heads in fall (August–October, inclusive) for every one seen in spring (March–May, inclusive). As the age ratio for that region was 0.5 young per adult, the fall numbers were about as expected. In east-central Illinois the spring-fall ratio was 1.0:1.6, and the age ratio was 0.6 young per adult, thus in line with the fall ratio. In west-central Illinois, where the age ratio was the highest—1.2 young per adult—the fall ratio was lowest, 1.0 in spring to 1.2 in fall. We cannot explain the discrepancy. In the south the spring-fall ratio was 1.0:1.1; our age-ratio data in the south were too scanty to evaluate.

Winter Populations

Red-headed woodpeckers have been found in all regions of the state in winter (Fig. 28), but such a statement tends to obscure the fact that massive changes occur every year in the red-head population between summer and winter. Fall migration shifts the population southward, generally leaving few birds in the northern region and much reduced numbers in the central region, whereas the population in southern Illinois may be greatly increased over the summer level. Mast production of oaks, beeches, and other food plants have a pronounced effect on the regular migrations of red-heads in fall and winter, and variation in the winter population is extreme. In some winters red-heads remain even in the north in large numbers (Schafer 1922; Fig. 29).

There is some evidence that the winter populations of red-heads have been extending their range northward. The great annual variation in winter populations makes this difficult to prove, but several observations, including the Christmas counts, suggest it. During his life time, Holland (1931) saw a definite increase in the winter population at the latitude of Knox County. Dr. S. C. Kendeigh's censuses of Trelease Woods in Champaign County also show a trend toward an increased winter population there. The extensive cross-country censuses of Alfred Gross and Howard Ray in the winter of 1906–1907 revealed no red-heads in the central region of the state although red-heads were found on both of our (1957 and 1958) cross-country winter censuses (Graber & Graber 1963). If there is a progressive change in

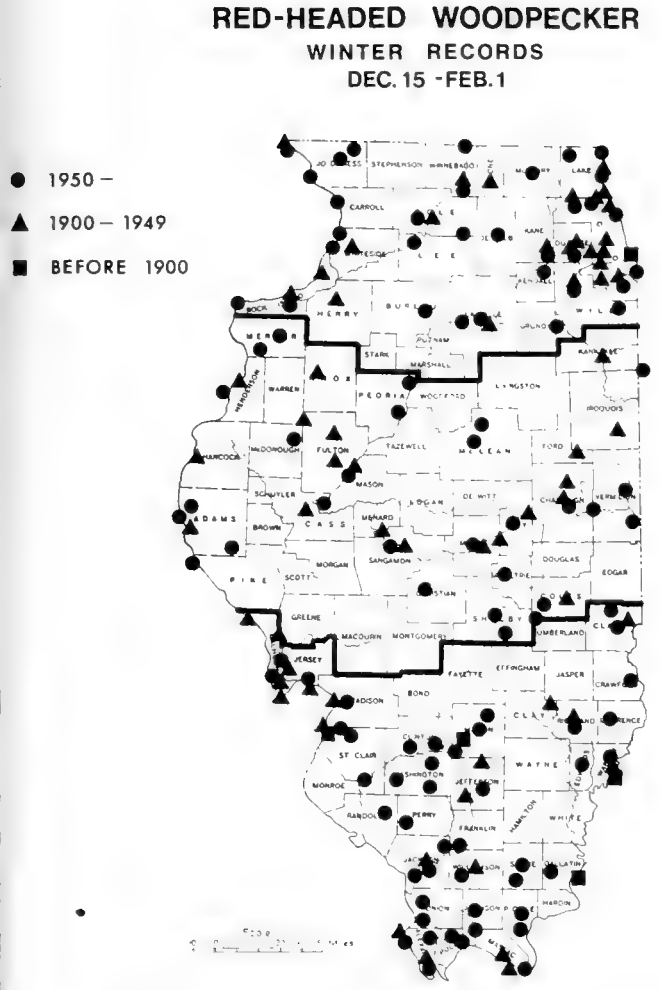

Fig. 28.—Distribution of winter records of the red-headed woodpecker in Illinois. Heavy horizontal lines separate the three regions (north, central, and south) referred to in the text.

range, it is very erratic, with notable regressions some years (Fig. 29).

As in summer, red-headed woodpecker populations in southern Illinois were censused in eight bottomland and five upland forests in the winters of 1973–1976. When all of the bottomland woods were considered, no significant correlations were found. However, when the two woods having the highest winter populations and the two woods having the lowest winter populations were examined, a few correlations were found. There was a positive correlation between the number of red-heads and oaks of acorn-bearing size, over 10 inches DBH ($r = 0.909$, $P = < 0.05$ for 1975 and $r = 0.961$, $P = < 0.01$ for 1976). These same four woodlands also showed a correlation between number of red-heads and the Importance of pin oak ($r = 0.839$, $P = < 0.10$ in 1975 and $r = 0.930$, $P = < 0.05$ in 1976).

Holland (1931) observed that the same oak woods were chosen for winter resorts by red-heads year after year in Knox County. Other observers (Musselman 1930; Mooney 1932; Willson 1970) have called attention to the red-head's affinity for oaks (and acorns) in winter. Willson (1970) and Reller (1972) suggest that maples also are important in the winter habitat.

In uplands the only wintering red-heads not found in woods adjoining bottomland woods were in a tract which had very heavy beech mast. In the following 2 years there was little or no beech mast in this woods, and no red-heads were found there. The average number of winter red-heads in bottomland woods (35 per 100 acres) was about four times the number (9 per 100 acres) in upland woods for the same 3-year period. There is an indication of an alternate high-low population fluctuation in our data. In 1973–1974 there were 20 red-heads per 100 acres (in all woods, upland and bottomland); in 1974–1975 there were 31 red-heads per 100 acres; in 1975–1976, 21 per 100 acres; and 58 per 100 acres in 1976–1977. This pattern of high red-head populations in the odd-numeral years is in agreement with the observations of Anderson (1965 and 1967), who noted the alternate-year cycle in Missouri, where the population was relatively low in (January) 1964, high in 1965, low again in 1966. The alternate-year pattern does not appear with any constancy in the Christmas counts. In the central region there are several-year runs of alternate high and low counts, but more often in the south there are 2, or sometimes 3, relatively high years followed by a drop (Fig. 29). We have found no statistically significant correlation between the annual counts in different regions of the state. The 5-year averages of the Chirstmas counts for the three regions of the state suggest an inverse relationship between winter populations of red-heads in southern versus central and/or

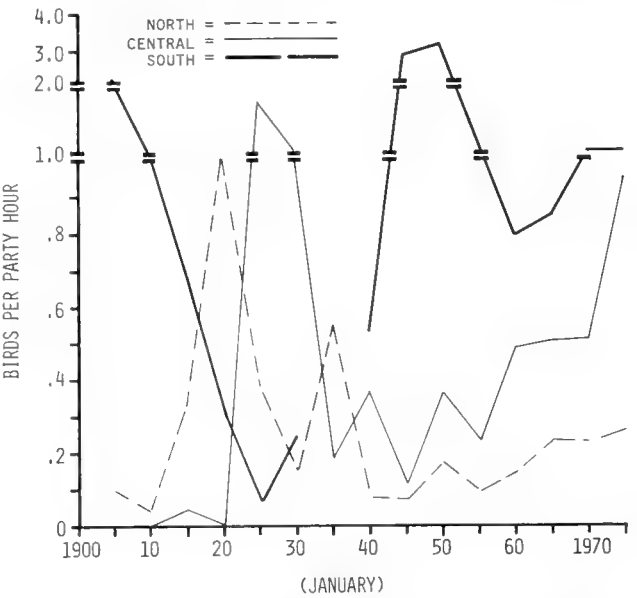

Fig. 29.—Red-headed woodpeckers seen per party hour on Audubon Christmas counts in the three regions of Illinois. Each point represents a 5-year average.

northern Illinois (Fig. 29). Annual variation in Christmas counts in recent years (1965–1975) for the red-head ranged from about 3 to 160 percent per year (excluding one change of 555 percent in the north, 1974–1975) and averaged about 45 percent per year in southern Illinois, 57 percent in central Illinois, and 43 percent in the north.

The statewide censuses of 1957–1958 show how varied the winter populations may be (see also Table 12). In the winter of 1956–1957 we estimated the state population of red-heads to be 92,000 (72 percent in the southern region), but the next winter the state population was 424,000 (98 percent in the south). This population appears to be an exception to the odd-year highs of the 1960's and 1970's mentioned above. The sources of these winter birds in Illinois are unknown.

Besides the great population shift to the south in winter, red-heads move from the more open forest edge and savannah habitats to forest proper almost exclusively. This change may be less a change in the bird than a change in the habitat, i.e., an opening of the forest from the loss of foliage, the forest thus becoming a well-lighted, more open habitat similar to that which the red-head occupies in summer. However, Reller (1972) observed a definite change in foraging by red-heads from ground foraging in summer to tree trunk and limb foraging in winter.

Food Habits

There are numerous brief observations on the food habits of the red-headed woodpecker in Illinois, but there are no comprehensive studies on the subject. Rice (1946) examined six specimens from Champaign County, and found that vegetable matter made up 70 percent of the food in winter, 45–50 percent in spring and fall, but was absent from the diet in summer, when insects, especially Lepidoptera and Coleoptera, comprised most of the food. Coleoptera were important in the diet (15–20 percent of the food) at all seasons, and Hymenoptera (25 percent) were especially important in fall, less so (10 percent) in summer. Forbes' (1882*a* and 1882*b*) study of four specimens taken in late May at a Tazewell County orchard heavily infested with canker worms showed that 80 percent of the red-heads' food was insects, mainly (64 percent) Coleoptera (ground beetles and scarabs) plus 15 percent Lepidoptera (canker worms), and 20 percent vegetable matter (corn). Red-heads commonly forage by "flycatching," but what they catch has not been recorded.

Among all the Illinois references to mast consumption by red-heads, little specific data are provided. Musselman (personal communication, 1962) and Smith & DuMont (1945*b*) have called attention to the importance of pin oak fruit in the fall and winter diet of red-heads in the Mississippi valley. Musselman also mentions red oaks as being attractive to red-heads (Mumford 1959*a*), and we have often seen them working on white oak acorns. However, the relative values to red-heads of the various species of acorns have not been studied. Also not yet studied is the red-head's use of acorns versus beechnuts or other mast.

Red-heads have been seen storing acorns in their

TABLE 12.—Winter populations of the red-headed woodpecker in various Illinois habitats.

Habitat	Acres	Birds per 100 Acres	Years (January)	Type of Census	Region or County	Reference
Urban residential	355	0	1976	Strip	North & Central	This paper
Urban residential	191	0–1 (avg 0.5)	1976	Strip	South	This paper
Oak-maple forest	55	0–42 (avg 12.5)	1954–1962	Map	Champaign (C) [a]	Kendeigh 1960*a*; Kendeigh & Brooks 1962
Oak-maple forest edge	1.25 miles[b]	0–23[b] (avg 6.8)	1963–1975	Map	Champaign (C)	Kendeigh & Brooks 1964*a*; Kendeigh & Clemans 1970
Forest (all types, including edge)	46	0–6 (avg 3.3)	1940–1941	Map	Piatt (C)	Johnston 1942
Forest (all types, including edge)	152	1–3 (avg 2.0)	1957–1958	Strip	Central	Graber & Graber 1963
Forest (all types, including edge)	241	1	1907	Strip	South	Graber & Graber 1963
Forest (all types, including edge)	211	2–15 (avg 8.1)	1957–1958	Strip	South	Graber & Graber 1963
Mature upland forest	772	0–33 (avg 8.2)	1974–1976	Strip	South	This paper
Mature bottomland forest	1,398	4–89 (avg 33.7)	1974–1976	Strip	South	This paper
Grazed bottomland forest	53	0–4 (avg 1.3)	1955–1957	Map	Macon (C)	Chaniot & Kirby 1955*a*, 1956; Kirby & Chaniot 1957
Shrubby field	40	0–7	1958–1965, 1968	Map	Lawrence (S)	Scherer et al. 1959; Shaw et al. 1968

[a] C refers to the central region of Illinois and S to the southern region, as shown on winter distribution maps, e.g., Fig. 5.
[b] These entries are miles of forest edge and birds per mile of edge.

own nest cavities (Jones 1933) and under the bark and in crevices of trees (Sanborn 1921). Moseley (1917) witnessed similar storage of suet, which may be used to attract these woodpeckers (Brintnall 1918; Williams 1924) although Schafer (1918) found cracked walnuts a more effective attractant. In South Dakota Winkenwerder (1902) reported red-heads storing live grasshoppers in tree crevices. The only reference on the amount of food materials stored is an anonymous (1922) observation of a red-head that worked throughout the winter at Moline, putting about 400 acorns and pieces of oak bark into two wren houses. The cache, which was never used, weighed 12¾ ounces at the end of the winter.

Formerly, at least, red-heads were sometimes considered pests on cultivated fruit, notably strawberries, cherries, pears, and apples (Gault, unpublished notes 1895; Le Baron 1855; Kinney 1868). Lyon (1923) found apples to be a good bait for trapping red-heads, and they also feed on mulberries in season. Southern (1966) observed one feeding on a dead gizzard shad in winter.

Beal's (1911) study of the red-headed woodpecker's food in North America showed the species to be much more of a vegetarian than most woodpeckers—animal matter constituting about 34 percent of the diet and vegetable matter 66 percent. Beetles, including most notably large adult predaceous ground beetles (Carabidae) and tiger beetles (Cicindelidae), made up about 19 percent of the food. The red-head was also less of a wood driller than other woodpeckers, taking few wood-boring larvae. Ants comprised about 5 percent of the year's food, going as high as 14 percent in June and July. Red-heads ate large numbers of grasshoppers in August (21 percent of the diet), and less in September (9 percent). Also in August and September grain, notably corn, became a significant part (22 and 19 percent, respectively) of the red-head's diet. Small fruits (blackberries, cherries, etc.) averaged about 3 percent of the year's food, going as high as 17 percent in July. Especially from October to January, mast (mainly acorns) became the predominant food, averaging about 55 percent of the diet.

Mortality and Longevity

In addition to the losses due to automobiles, mentioned earlier in this paper, red-heads are also lost because of pesticides. Montgomery (1956) found one dead after DDT was sprayed on trees to control Dutch elm disease, and a nest failed when both adults succumed to a tree spray (Mumford 1961). Red-heads were 3 of 259 prey items in screech owl boxes (Brown & Bellrose 1943).

There are few published Illinois records of longevity and none of more than 2 years (Lincoln 1927; Cooke 1937). Subfossil remains of red-headed woodpeckers were found at the Modoc Rock Shelter and were aged 3,000–8,000 B.C. (Parmalee 1959).

LEWIS' WOODPECKER
(Asyndesmus lewis)

There are two sight records of Lewis' woodpecker for the state, one on 24 May and 26 May 1923 in Roger's Park (Evanston) on the north side of Chicago (Hine 1924) and one on 14 May 1932 at Argo (Summit) on the south side of Chicago (Ford 1956).

YELLOW-BELLIED SAPSUCKER
(Sphyrapicus varius)

(Fig. 30 and 31)

Spring Migration

Yellow-bellied sapsuckers may be found in all parts of Illinois in winter, but the spring migration becomes conspicuous as the numbers of sapsuckers increase in March and April (Fig. 32). The migration has apparently never been witnessed directly in spring, and may be strictly, or at least largely, nocturnal (see under Fall Migration). A large kill of 141 sapsuckers in or along the beaches of Lake Michigan on the night of 16 April 1960 may have occurred while the birds were in night migration (Segal 1960). A similar incident involving only two sapsuckers near Waukegan on 2 May was reported by Boulton & Pitelka (1937).

February records refer most often to the winter population, but apparent migration waves may be detected as early as 21 February, particularly in southern Illinois. More typically the first waves are noted after 15 March, with noticeable influxes occurring between 21 and 31 March (Oberholser 1928; Smith 1930). Musselman (1932) recorded one large influx on 14 March at Quincy. Peak numbers of sapsuckers come even later, in early and mid-April, and most of them have passed north of Illinois by the end of April (Fig. 32). In some years, particularly in east-central and northeastern Illinois, large numbers of transient sapsuckers appear. Beal (1886) recorded such an invasion on 9 April 1886, the birds remaining for 3 days. Except for such invasions, sapsuckers are usually seen singly or in twos, and generally one sees not more than five per day.

In southern Illinois very few sapsuckers linger past April, the latest date on record being 5 May (Oberholser 1928; George 1968). In central and northern Illinois, where a very thin and spotty breeding population survives, a few sapsuckers stay on through the summer, but nearly all sapsuckers seen in Illinois are transients, which pass through central and northern Illinois by mid-May (Fig. 32).

Benjamin Gault's unpublished records from 1875 to 1927 in northeastern Illinois indicate that males tend to predominate in numbers in the early spring migration through the first week in April after which

Fig. 30.—Immature yellow-bellied sapsucker. Photo taken by J. W. Graber in Busey Woods (Urbana, Illinois) in April. Inset shows adult yellow-bellied sapsucker. Photo by Dr. W. J. Beecher, Chicago Academy of Sciences.

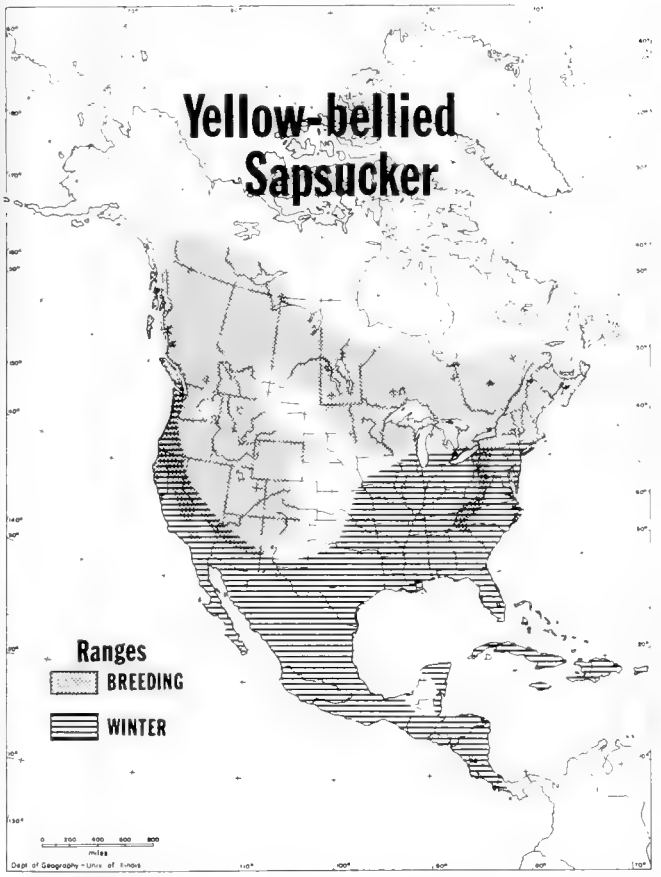

Fig. 31.—General distribution of the yellow-bellied sapsucker. The range shown here may include large sections in which populations of the species are thin or absent because of the nature of the terrain and lack of suitable habitat.

females become more common and predominate in the later migrations after 20 April. The transients show a broad tolerance for woody habitats, occurring in urban areas as well as in extensive forests. Actual measurements of transient populations of sapsuckers are lacking for any habitat.

Distribution

In eastern North America the yellow-bellied sapsucker nests in the northern USA and Canada, but the breeding range extends well south in the western USA as well as in the mountains of the east (Fig. 31).

In Illinois the breeding range is very spotty (Fig. 33) and probably now restricted to northern and central Illinois though suitable looking habitat is plentiful in southern Illinois. The old record for St. Louis (Fig. 33) is that of Hurter (1884). The fact that neither Ridgway (1889) in southeastern Illinois nor Widmann (1907) in the St. Louis area knew the sapsucker as a breeding species in their respective areas implies that the species was not a common nester in the south even in the last century. The significance of a sight record for a sapsucker at Horseshoe Lake (Alexander County), 13 August 1932 (Gower 1933) is uncertain.

Nesting Habitats and Populations

No breeding population of sapsuckers has been measured systematically in Illinois. Petersen's (1956) discovery of three active nests in Henderson County in 1 day (19 June 1955) and DuMont's (1936) reference to the species on the Des Moines River across the Mississippi from Illinois indicate that there are measurable populations in or near the Mississippi valley. In the Illinois valley Loucks (1891) considered the species rare at Peoria, but a short distance to the north, in Marshall County, Barnes (1890) called it "tolerably common."

The preferred nesting habitat is lowland forest subject to flooding (Barnes 1890; DuMont 1936; Petersen 1956). There is also an indication of sapsuckers nesting in urban residential habitat (Roberts 1922).

No territories have been measured in any habitat.

Nesting Cycle

Nesting of the sapsucker has not been studied in Illinois. Near Peoria Silloway (unpublished manuscript 1923) observed what he called nuptial activities of sapsuckers (possibly transients) on 6 April, noting that the birds were very noisy. The call most often heard in Illinois is a distinctive catlike squeal.

Nest cavities in Henderson County were 30–45 feet high in living oaks (Petersen 1956). In Marshall County R. M. Barnes found nests in both dead and live willows, the nest height varying from 12 to 20 feet (Chicago Museum of Natural History oological collection). Loucks (unpublished manuscript 1891) describes a nest 15 feet up in a dead tree in Tazewell County.

Old literature and museum records indicate that egg laying by sapsuckers in northern Illinois extends from at least 20 April to 3 June (see also Bent 1939). The same sources indicated that clutch size varies usually from four to six eggs. Barnes considered the clutch of eight eggs that he found near Lacon to be very exceptional (Chicago Museum of Natural History oological collection).

There are no data on nesting success in Illinois.

Fall Migration

Aside from the very slim breeding population, sapsuckers do not appear in Illinois again until September. Benjamin Gault's long-term records show that sapsuckers are rarely seen before 10 September even in northern Illinois (see Schafer 1923; Blake & Smith 1941 for early records). They increase conspicuously in northern and central Illinois between 15 and 24 September, and most of them have passed through the north by 12 October and through central Illinois by 20 October (Fig. 32). Our earliest fall record for the

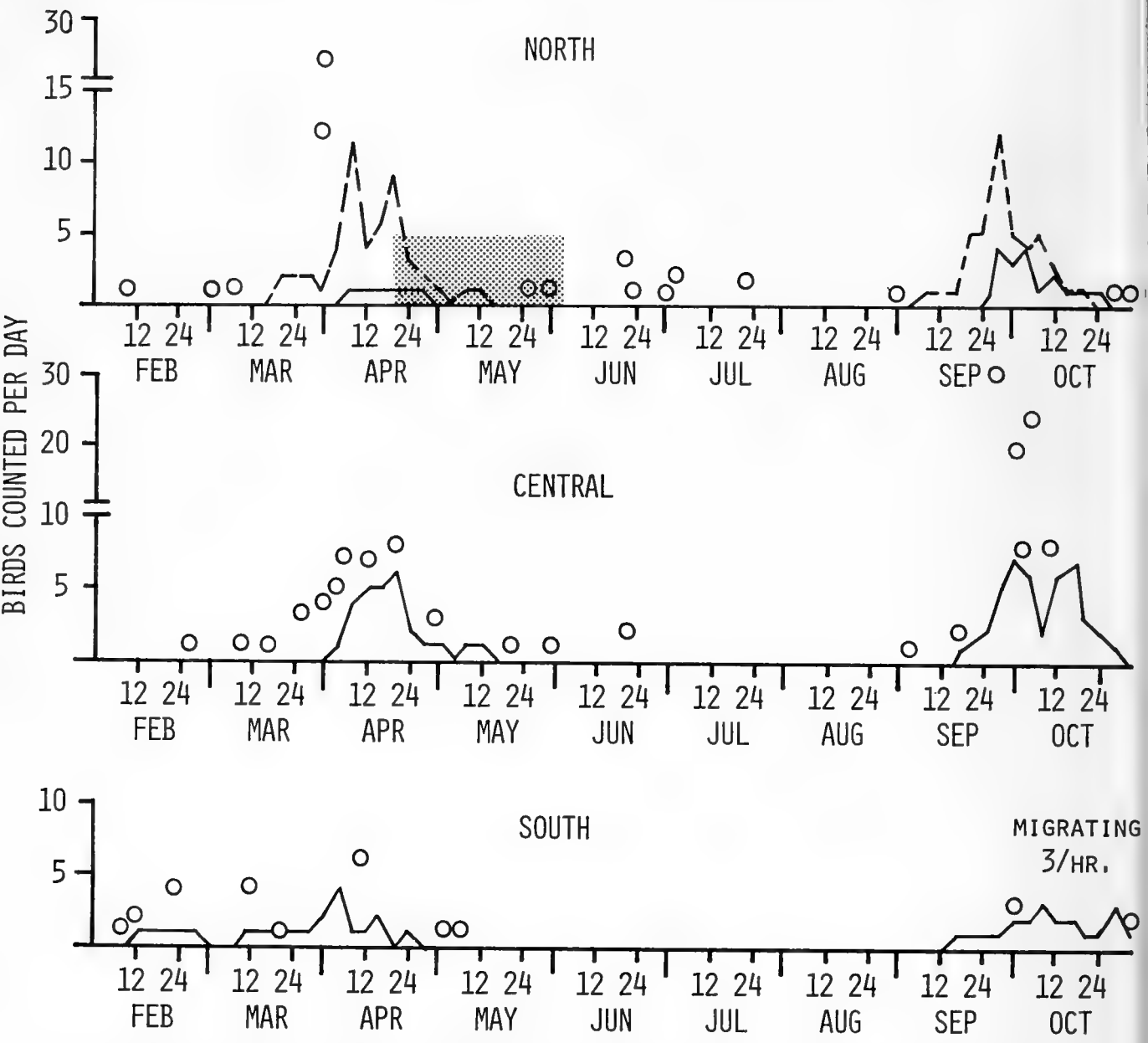

Fig. 32.—Egg-laying and migration seasons of the yellow-bellied sapsucker in different regions of Illinois. Spring and fall graph lines show the higher daily count of each 4 days (1967–1970). The dashed graph line (north) represents the cumulative counts of sapsuckers made by Benjamin T. Gault between 1875 and 1927, mainly in Du Page County. Hollow circles represent counts made in other years or by other observers. The shaded area (north only) shows the span of dates during which egg laying has been recorded.

south was 17 September. Because the migrant population of sapsuckers in the south appears low (Fig. 32) and the winter population there is relatively high, the end of the fall migration in the south is obscured. Peak numbers of transient sapsuckers have been seen 20 September–8 October in northern Illinois, 28 September–18 October in central Illinois, and 8–28 October in southern Illinois. Balch (1970) observed a large wave of sapsuckers at Waukegan 22 September 1970.

The data on bird kills at television towers in central Illinois also show the migration pattern of sapsuckers there. The kill data span August–November 1955–1972, during which period about 12,000 dead birds (all species) were picked up and identified. All (43) of the sapsuckers were killed between 23 September and 7 October (Brewer & Ellis 1958; Petersen 1959), a period in which sapsuckers constituted about 1 percent of all (4,400) birds killed. Nearly all of these sapsucker specimens, adults and immatures, were still clearly in the molt on the head and anterior body. Graber's (1968) view that few sapsuckers are killed compared with the number seen is yet to be verified.

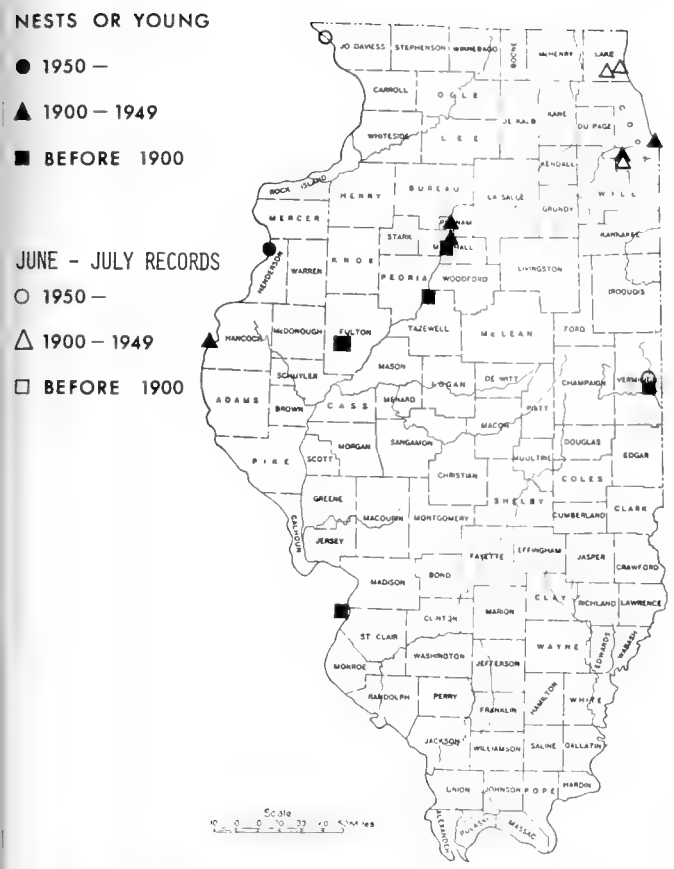

Fig. 33.—Distribution of breeding records of the yellow-bellied sapsucker in Illinois.

Most of the migration must be nocturnal. Besides the evidence of the tower kills, we have heard what we believed to be sapsuckers uttering the characteristic cat call while migrating at night (8:20 p.m.–5:20 a.m.) over east-central Illinois between 12 September and 14 October. We have seen diurnal migration of sapsuckers but once—1 October 1972 (morning), the birds flying with jays and other woodpeckers down the Ohio valley in Pope County.

Our counts showed a ratio of 1.0 sapsucker in spring to 1.8 in fall statewide, but there was a progressive decline in the ratio from north (1.0 to 2.9) to central (1.0 to 1.9) to south (1.0 to 1.3). The age ratio in a small sample (22) of specimens from a central Illinois tower kill was 1.0 adult to 1.75 immatures.

Winter Populations

Yellow-bellied sapsuckers have been found in all regions of the state in winter (Fig. 34), but the population declines progressively from south to north, as the Christmas count data clearly show (Fig. 35). The occurrence of sapsuckers in the north in winter is irregular (Duncan 1937), in some years falling virtually to zero (Fig. 35), but annual variation is great in all regions. The long-term averages of Christmas count data show that it has taken about 92 party hours of observation to find a sapsucker in the north, versus 45 hours in central Illinois, and 17 in the south.

Judging from population densities, we conclude that bottomland forest and residential areas are the favorite winter habitats. The highest population we have measured in a tract at least 40 acres in size was about 12 sapsuckers per 100 acres in a mature bottomland forest in Alexander County in January 1975, a year with notably high populations in the south (Fig. 35). Average populations were 1.6 sapsuckers per 100 acres in both mature bottomland and urban residential habitat in the south, but only 0.4 per 100 acres in mature upland oak-hickory. Shrub habitat is also used in the south (Shaw 1961; Table 13).

Prior to about 1939 the Christmas counts had too few knowledgeable participants in Illinois to detect sapsuckers with any regularity The record since then

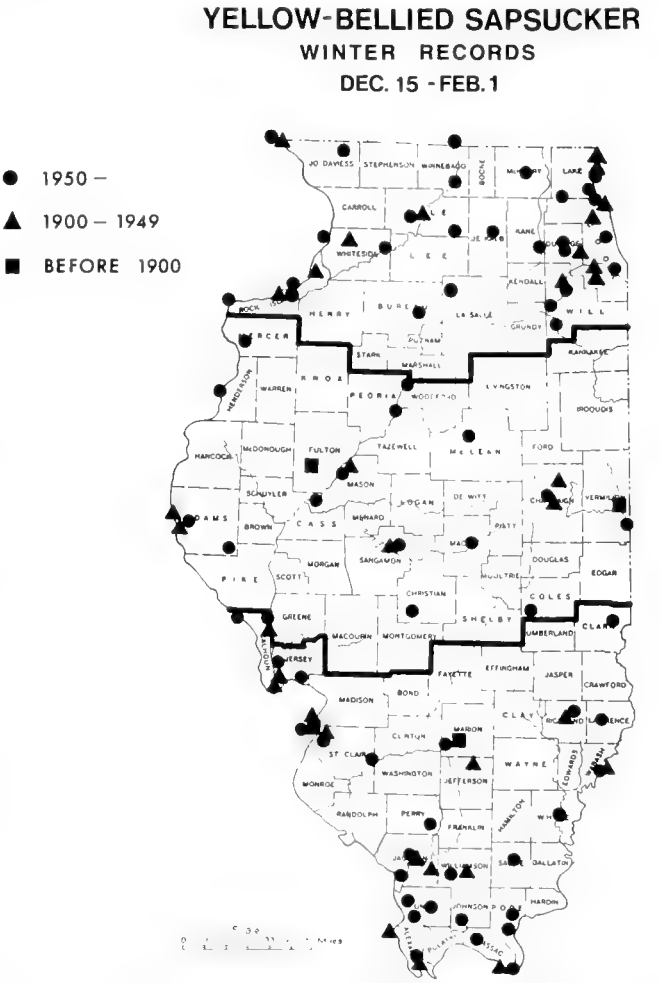

Fig. 34.—Distribution of winter records of the yellow-bellied sapsucker in Illinois. Heavy horizontal lines separate the three regions (north, central, and south) referred to in the text.

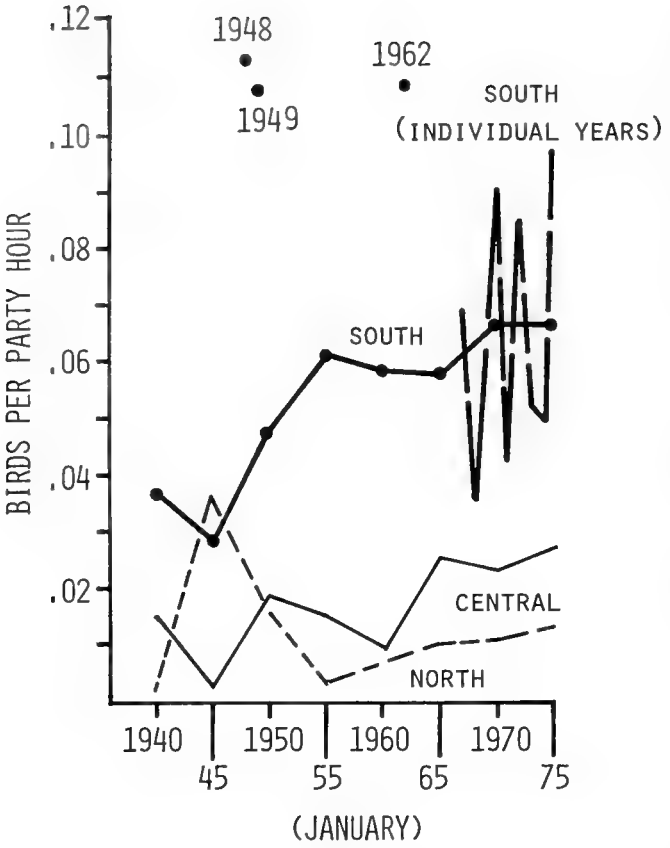

Fig. 35.—Yellow-bellied sapsuckers seen per party hour on Audubon Christmas counts in the three regions of Illinois. Each point represents a 5-year average. The dash line shows annual fluctuations in the southern Illinois counts in recent years. Dots designate high counts in 1948, 1949, and 1962.

shows an upward trend in winter numbers in more recent years (Fig. 35) though the highest count was in the southern region in January 1948, a high also noted by Cunningham (1948). The southern counts for 1949 and 1962 were also exceptionally high (Fig. 35). Extreme annual variation in the counts makes any conclusion tenuous, particularly as the aggressiveness of Christmas count participants in finding birds has also been increasing over the years. The counts show some tendency toward alternate year highs and lows (Fig. 35), but the pattern is far from consistent. The early cross-country censuses of Alfred Gross and Howard Ray, conducted in southern Illinois in February 1907 may also indicate that the sapsucker winter population is increasing. They detected no sapsuckers in 241 acres of forest, whereas we found an average of about two sapsuckers per 100 acres in 1957–1958 (Table 13). However, there is now no way we can determine whether 1907 was a "low" year for sapsuckers.

Sapsuckers were about four times as numerous in bottomland woods as in upland woods in southern Illinois. They prefer larger trees ($r = 0.924$, $P = < 0.001$ between numbers of trees over 22 inches DBH and numbers of sapsuckers). The sapsucker population proportionately increased in woods with greater numbers of large trees (Fig. 36). There was also a negative correlation ($r = -0.804$, $P = < 0.01$) between sapsucker numbers and the percentage of the total basal area of a forest made up of small trees, 4–10 inches DBH.

The composition of bottomland woodlands favored by wintering sapsuckers reflected their food preferences. Maples usually constitute more than 15 percent in Importance (Y), elms more than 10 percent, and oaks less than 25 percent. There were positive correlations between the numbers of sapsuckers and the Importance of pecan ($r = 0.617$, $P = < 0.10$); pecan and sugar maple (the latter not very numerous in bottomland) ($r = 0.820$, $P = < 0.01$); pecan, sugar maple, and tulip tree ($r = 0.733$, $P = < 0.05$); and elms ($r = 0.604$, $P = < 0.10$). There was a negative correlation for the Importance of oaks ($r = -0.601$, $P = < 0.10$). Sapsuckers seldom drill the species of oaks that are dominants in these woodlands. The sapsucker apparently shares the winter habitat of the red-bellied woodpecker and downy woodpecker, as its numbers correlate with numbers of those species ($r = 0.736$ and 0.742, respectively, $P = < 0.05$).

TABLE 13.—Winter populations of the yellow-bellied sapsucker in various Illinois habitats.

Habitat	Acres	Birds per 100 Acres	Years (January)	Type of Census	Region or County	Reference
Urban residential	164	0.6	1976	Strip	North	This paper
Urban residential	191	1.6	1976	Strip	South	This paper
Suburban woodlot	20	0–(+) [a]	1968–1972	Map	Lake (N) [b]	Miller & Miller 1968
Forest (all types, including edge)	241	0	1907	Strip	South	Graber & Graber 1963
Forest (all types, including edge)	211	1–4 (avg 2.4)	1957–1958	Strip	South	Graber & Graber 1963
Mature bottomland forest	1,398	0–12 (avg 1.6)	1974–1976	Strip	South	This paper
Mature upland forest	772	0–6 (avg 0.4)	1974–1976	Strip	South	This paper
Shrubby field	40	0–2	1958–1965, 1968	Map	Lawrence (S)	Shaw 1958, 1961

[a] The plus symbol (+) indicates fewer than one bird per 100 acres.
[b] N refers to the northern region of Illinois and S to the southern region, as shown on winter distribution maps, e.g., Fig. 5.

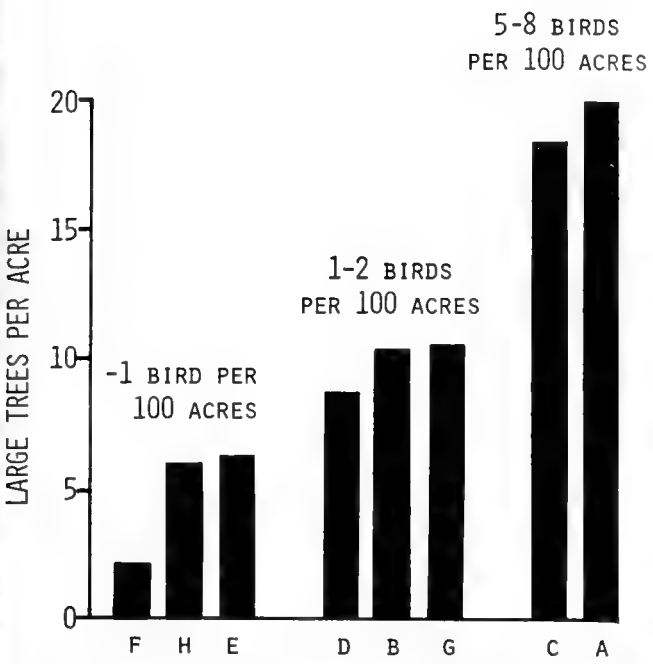

Fig. 36.—Relationship of yellow-bellied sapsuckers to large trees (trees over 22 inches DBH). Bars represent eight different bottomland woods in southern Illinois.

The upland woods in which wintering sapsuckers were found in southern Illinois were adjacent to bottomland woods and had more maples (mostly sugar maples) than had upland woods in which no sapsuckers were found (the Importance of maples was greater than 9 percent in upland woods with sapsuckers present).

Food Habits

Though there are a number of references to the presence of sapsuckers at winter feeding stations (Beall 1908; Smith & DuMont 1945*b*; Fawks 1966 and 1970), few tell what food was taken by the species. Musselman (1933) mentions sapsuckers eating suet. Sapsuckers have also been observed feeding on the fruit of hawthorn (*Crataegus* sp.), "matrimony vine" (DuMont 1947*a*), and "winterberry" (Link 1940).

Most of the Illinois literature on the food of sapsuckers concerns tree drilling (Fig. 37). Though other woodpeckers feed to some extent on cambium and sap, the sapsucker clearly lives up to its name when it comes to this method of foraging. Beal (1911) found that the sapsucker's food through the year was about 49 percent animal, and 51 percent vegetable, making it the only woodpecker he studied that eats more vegetable than animal matter. Ants were apparently the favorite animal food, constituting about 34 percent of the diet and being taken throughout the year but most commonly from May to August. Various beetles were also important in the diet, making up about 5 percent of the food.

The common types of vegetable food for sapsuckers were fruit (28 percent of the diet) and cambium (16.5 percent). The fruit, notably a variety of wild berries, was taken mainly in fall (71 percent of the

Fig. 37.—Yellow-bellied sapsucker drill holes on a mature sugar maple, a favorite food source of this bird.

food in November). Cambium was eaten most in winter and spring, constituting about 49 percent of the food in April and only 1.5 percent in November. Interesting is the observation of Southern (1966) of a sapsucker feeding on dead gizzard shad in winter.

In his extensive investigation McAtee (1911) found that the sapsucker attacked no fewer than 246 species of native North American trees, 61 species of native vines, and 31 introduced trees.

In Illinois we have found sapsucker drillings in 88 species of woody plants, 72 of which are listed in Table 14. In southern Illinois woodlands the species most often showing sapsucker drillings (excluding data from small samples) are overcup oak, slash pine, tulip tree, pecan, red cedar, and silver and sugar maples. The high incidence of sapsucker drillings in overcup oak (42.8 percent) is surprising, since all other oaks (660 trees) observed in the south had a combined

TABLE 14.—Woody plants[a] drilled by the yellow-bellied sapsucker in Illinois.

Species	North		East-Central		South		Site
	Number Examined	Percent Drilled	Number Examined	Percent Drilled	Number Examined	Percent Drilled	
Ash, green (*Fraxinus pennsylvanica*)	51	2.0	...	...	56	5.4	Bottomland woods
white (*F. americana*)	44	0	57	10.5	60	0	Upland woods, urban
Beech, American (*Fagus grandifolia*)	...	...	4	0	121	3.3	Upland woods, urban (central)
Birch, paper (*Betula papyrifera*)	...	...	39	89.7	2	100.0	Urban
river (*B. nigra*)	...	...	...	...	75	0	Bottomland woods
Boxelder (*Acer negundo*)	82	1.2	3	0	69	8.7	Bottomland woods
Butternut (*Juglans cinerea*)	11	27.3	...	...	5	60.0	Upland woods
Catalpa (*Catalpa bignonioides*)	1	0	13	15.4	1	0	Urban
Cedar, Chinese (*Juniperus chinensis*)	...	...	25	60.0	3	0	Urban
red (*J. virginiana*)	93	73.1	...	...	38	31.6	Upland woods
Cherry, black (*Prunus serotina*)	63	4.8	48	14.6	15	0	Bottomland & upland woods, urban
Coffee tree, Kentucky (*Gymocladus dioicus*)	3	0	4	0	12	0	Bottomland woods
Cottonwood (*Populus deltoides*)	56	3.6	62	4.8	61	0	Bottomland woods
Cypress, bald (*Taxodium distichum*)	6	0	5	20.0	59	6.7	Urban, bottomland woods (south)
Elm, American (*Ulmus americana*)	36	28.1	37	37.8	136	6.6	Bottomland woods
Siberian (*U. pumila*)	3	33.3	11	9.1	...	...	Urban
slippery (*U. rubra*)	69	5.8	17	35.3	8	25.0	Bottomland woods
winged (*U. alata*)	...	...	...	...	20	0	Upland woods
Ginko (*Ginko biloba*)	...	...	11	72.7	...	...	Urban
Gum, black (*Nyssa aquatica*)	...	...	...	...	38	5.2	Bottomland woods
sour (*N. sylvatica*)	...	...	3	33.3	38	0	Upland woods, urban (central)
sweet (*Liquidambar styraciflua*)	...	...	32	84.4	115	2.6	Bottomland woods, urban (central)
Hackberry (*Celtis occidentalis*)	37	0	43	0	59	1.7	Bottomland, urban
Hawthorn (*Crataegus* sp.)	...	...	9	33.3	6	0	Bottomland, urban
Hickory, bitternut (*Carya cordiformis*)	13	61.5	2	50.0	25	12.0	Bottomland woods, slopes
kingnut (*C. laciniosa*)	...	...	...	...	62	17.7	Bottomland woods
mockernut (*C. tomentosa*)	...	...	6	66.7	75	25.3	Slopes, upland woods
pignut (*C. glabra*)	...	...	18	44.4	56	10.7	Upland woods
shagbark (*C. ovata*)	68	54.4	104	53.8	127	23.6	Slopes, bottomland woods
sweet pignut (*C. ovalis*)	...	...	...	...	11	0	Slopes, upland woods
Ironwood (*Ostyra virginiana*)	39	20.5	19	57.9	15	0	Upland woods, slopes
Larch, European (*Larix decidua*)	...	...	31	3.2	...	...	Urban
Linden, American (*Tilia americana*)	84	23.8	62	79.0	3	33.3	Slopes, upland woods, urban
Locust, black (*Robinia pseudoacacia*)	...	...	25	0	11	0	Upland woods
honey (*Gleditsia* sp.)	3	0	48	0	26	4.2	Urban, bottomland woods
Magnolia (*Magnolia grandiflora*)	...	...	...	...	29	75.9	Urban
Maple, Norway (*Acer platinoides*)	...	...	24	8.3	...	...	Urban
silver (*A. saccharinum*)	132	3.0	149	16.1	240	27.5	Bottomland woods
sugar (*A. saccharum*)	100	53.0	60	88.3	158	25.9	Woodland slopes
Mulberry (*Morus* sp.)	15	0	28	0	1	0	Bottomland woods
Musclewood (*Carpinus caroliniana*)	...	...	...	...	60	8.3	Bottomland woods and slopes

drilling incidence of only 1.5 percent. A rather uncommon tree, the butternut, showed a high incidence (60 percent of 5 trees). Many southern forest trees, e.g., ashes, sweet gum, hackberry, and sycamore, which were fairly abundant were little used by sapsuckers.

Which trees are drilled may depend upon the sugar content of the sap (Kilham 1964), but the species of trees preferred by sapsuckers may be determined by more than the sugar content of the sap. Other chemical constituents (e.g., tannins in oaks, Havera et al. 1976) may influence the birds' preferences. It seems providential for the sapsucker that sucrose and raffinose sugars in tree saps increase greatly in late winter and early spring (Anderssen 1929; Zimmermann & Wilburn 1975), a time when other food sources may be scarce. The increase of sap and its nutrient content at an injury site (Kilham 1964) also benefits the bird and may have been instrumental in the evolution of the habit of sap sucking.

In east-central Illinois woods the favorite trees for sapsuckers, based on drilling frequencies, were sugar maples, lindens, pignut and shagbark hickories, and ironwood. Williams (1975) found that sapsuckers in his study area in east-central Illinois spent more time on hickories than on any other trees. In an urban situation (Urbana, Illinois) the trees most often drilled by sapsuckers were paper birch, Austrian and Scotch pine, tulip tree, linden, sweet gum, ginko, and Chinese cedar. In northern Illinois (La Salle, Ogle, and Winnebago counties) the trees most often drilled were red cedar, shagbark hickory, sugar maple, and Scotch pine.

Considering that winter sapsuckers are primarily bottomland forest birds, the trees in upland woods showed a surprisingly high incidence of sapsucker drilling (Table 14). Migrant sapsuckers may be just as plentiful in upland as in bottomland forest. The total amount of forest in an area may help to determine which trees sapsuckers will drill, the birds using upland forest or urban trees to a greater extent when there is little native bottomland forest in an area.

Some tree species showed a gradation in the inci-

TABLE 14.—Continued.

Species	North		East-Central		South		Site
	Number Examined	Percent Drilled	Number Examined	Percent Drilled	Number Examined	Percent Drilled	
Oak, black (*Quercus velutina*)	92	0	30	0	81	0	Slopes
bur (*Q. macrocarpa*)	19	26.3	67	28.4	4	0	Bottomland woods
cherrybark (*Q. falcata pagodaefolia*)	...	...	...	...	34	0	Bottomland woods
overcup (*Q. lyrata*)	...	...	...	...	28	42.8	Bottomland woods
pin (*Q. palustris*)	...	...	42	23.8	70	1.4	Bottomland woods
post (*Q. stellata*)	...	...	...	...	99	3.0	Upland woods
red (*Q. rubra*)	37	0	103	1.9	105	0	Slopes
shingle (*Q. imbricaria*)	...	...	9	0	8	0	Upland edges of woods
Shumard's (*Q. shumardii*)	...	...	3	0	38	2.6	Bottomland woods
white (*Q. alba*)	101	1.0	80	10.0	200	1.0	Upland woods
yellow chestnut (*Q. muhlenbergii*)	...	...	...	...	21	9.5	Slopes
Olive, Russian (*Eleagnus angustifolia*)	...	...	12	100.0	...	...	Urban
Pecan (*Carya illinoiensis*)	...	...	...	...	61	31.1	Bottomland woods
Persimmon (*Diospyros virginiana*)	...	...	8	0	21	0	Upland, urban (central)
Pine, Austrian (*Pinus nigra*)	...	...	49	98.0	...	...	Urban
loblolly (*P. taeda*)	...	...	...	...	138	21.0	Forest plantations
Scotch (*P. sylvestris*)	38	97.4	62	87.1	...	...	Forest edge plantation
short-leaf (*P. echinata*)	...	...	...	...	86	23.3	Upland woods
slash (*P. caribaea*)	...	...	...	...	82	32.9	Forest edge plantation
western yellow (*P. ponderosa*)	20	0	...	...	...	...	Forest edge plantation
white (*P. strobus*)	167	25.1	35	8.6	15	20.0	Upland woods (north), urban & plantation
Redbud (*Cercis canadensis*)	3	0	30	0	3	0	Upland woods, urban
Sassafras (*Sassafras albidum*)	...	...	8	0	22	0	Upland woods
Sycamore (*Platanus occidentalis*)	18	27.3	63	20.1	97	1.0	Bottomland woods, urban (central)
Spruce, Norway (*Picea abies*)	77	9.1	36	19.4	...	...	Forest plantation, urban
Sugarberry (*Celtis laevigata*)	...	...	...	...	34	0	Bottomland woods
Sumac, staghorn (*Rhus typhina*)	...	...	10	0	...	...	Urban
Tree-of-heaven (*Ailanthus altissima*)	...	...	28	0	...	...	Urban
Tulip tree (*Liriodendron tulipifera*)	...	...	39	74.4	51	37.3	Upland woods, urban (central)
Walnut (*Juglans nigra*)	23	21.7	43	18.6	44	11.4	Upland woods, urban
Willow, black (*Salix nigra*)	58	6.9	6	50.0	6	0	Bottomland woods

[a] Tree species of which fewer than 10 occurred in our sample for the state have been omitted from this table.

dence of sapsucker use from the northern part of the state to the southern part, e.g., the silver maple (Table 14). It would be interesting to know if there is a gradient in the sugar content of the sap from north to south in the silver maple. We noted that different tree species were drilled in different parts of the tree and that different species were apparently attacked at different ages. Sugar and silver maples were often drilled at the base of the trunk when the tree was fairly large (old). On the other hand, shagbark hickories were often drilled at the 10- to 15-foot level while the tree was fairly young. Inspection from the ground level may give an erroneous impression of the incidence of use by sapsuckers of a certain tree species. For instance, the bur oak appears to be attacked while fairly young. Later growth and the increase in heavy corky bark tends to obscure old drill holes. Cottonwoods appear to be drilled fairly high in the tree while the tree is fairly young; thus, examinations of old cottonwoods may not allow a ready view of sapsucker holes from the ground level.

The locations of trees appear to influence the incidence of sapsucker attacks also. The presence of a more desirable (to the sapsucker) species may reduce the use of a less desirable tree species in the immediate vicinity. Thus, in a grove of Scotch and Austrian pines, about 10 percent of the Scotch pines were used though the Austrian pines were all heavily drilled. In another location, which had only Scotch pines, 85 percent of them were drilled by sapsuckers. In some locations only less preferred trees occur, and in these places such trees may be used of necessity, which might account for the frequent drilling in parks and urban plantings of sweet gum and sycamore, species relatively little used in the native woodlands that we examined. We also wonder if certain introduced tree species are more vulnerable to sapsuckers because no sapsuckers occur in the original ranges of these trees, and hence, no defense mechanism has been evolved by them. This lack of defense might explain the high incidence of sapsucker attacks on certain introduced pines (e.g., Austrian and Scotch pines) as compared with native pines (e.g., white pine and short-leaf pine). In New Hampshire Kilham (1964) found that sapsuckers were more likely to attack trees which had previously been injured.

In addition to the woody plants listed in Table 14, we also found sapsucker holes in these species: common apple (*Malus pumila*), arbor-vitae (*Thuja occidentalis*), horse chestnut (*Aesculus hippocastanum*), Zumi crabapple (*Malus zumi*), grape (*Vitis* sp.), American holly (*Ilex opaca*), magnolia (*Magnolia soulangeana*), black maple (*Acer nigrum*), osage orange (*Maclura pomifera*), paw paw (*Asimina triloba*), jack pine (*Pinus banksiana*), red pine (*P. resinosa*), poison ivy (*Rhus radicans*), white poplar (*Populus alba*), rowan (*Sorbus aucuparia*), and weeping willow (*Salix babylonica*). These species were not listed in Table 14 because of sample size (fewer than 10 trees observed). McAtee (1911), Gault (unpublished notes 1891–1921), and Wright (1926) observed sapsucker damage on these additional species in Illinois: red maple (*Acer rubrum*), flowering dogwood (*Cornus florida*), magnolia (*Magnolia tripetala*), shadbush (*Amelanchier* sp.), garden plum (*Prunus domestica*), and lilac (*Syringa* sp.).

The present list obviously does not quantitatively reflect Illinois tree populations. The list is far from complete and does not include large portions of Illinois, but more important than a complete list are quantitative data on the relationship between sapsucker populations and tree populations. Swink (1965) found the trees most frequently attacked by sapsuckers at Morton Arboretum, Lisle, were "pines," "spruce," tulip tree, sugar maple, basswood, and cottonwood. He pointed out that sapsuckers showed a preference for the tops of cottonwoods, which is where we also often see them working near the ends of the higher vertical branches. Swink's (1959) study of perching sites of sapsuckers, mainly in April in northeastern Illinois, showed the most frequently used trees to be American elm, cottonwood, sugar maple, linden, white oak, black locust, slippery elm, and white ash.

Sapsuckers can be very destructive to trees, disfiguring or even killing them. It usually takes several years of sapsucker attacks to kill a tree, and even then the direct cause of death may be some other agent, such as fungus or bacteria that invade the sapsucker wounds. We have found no reference to economic damage to forests by sapsuckers in Illinois, where the sapsucker winter populations are relatively low, but the problem has been serious in areas further south (McAtee 1911). Sapsuckers have, at times, been a local problem in southern Illinois orchards, but the extent of the problem has never been measured quantitatively. Complaints about sapsucker damage to yard plantings seem to be increasing in Illinois, both in our experience and that of Eugene Himelick, plant pathologist, Illinois Natural History Survey. To some extent, this increase probably reflects the greatly increased human population in urban areas and the accompanying cost of, and pride in, landscape plantings.

HAIRY WOODPECKER
(Dendrocopos villosus)

(Fig. 38 and 39)

Spring Populations

There is no evidence of migration in Illinois populations of the hairy woodpecker. Our counts of this species are consistently low, and the spring counts (Fig. 40) show less day-to-day variation through the

season than those for any other woodpecker except the pileated, also a non-migratory species.

Distribution

The hairy woodpecker has a very wide distribution in North and Central America (Fig. 39). In Illinois the species is probably to be found the year around in nearly every township though published records are still lacking for large areas of the state (Fig. 41).

Nesting Habitats and Populations

The hairy woodpecker is essentially a forest species in summer with very low populations, or none at all, in other habitats. The species occupies both up-

Fig. 38.—Hairy woodpecker. The strong bill and immaculate outer tail feathers are characteristic of the species (compare with downy woodpecker, Fig. 44).

land and lowland forest, apparently favoring bottomland woods at least in central and southern Illinois. Gates (1911) called the hairy a dominant species of both bottomland woods and the more mesic upland forest. In our censuses of southern Illinois forests, we found more hairies, on average, in bottomland woods than upland (Table 15). The highest populations (10–24 birds per 100 acres) have been recorded in virgin or mature bottomland forest in central Illinois (Table 15). There are no measurements of hairy populations in bottomland woods for northern Illinois, but Schafer's 1914–1923 unpublished censuses of upland forest in Rock Island showed high populations for that habitat compared to those in the central and southern regions (Table 15). Our strip censuses in 1957 and 1958 in the north, of 177 acres (about 16 miles) of forest (nearly all upland), did not intercept a single hairy! The observation implies a population decline since Schafer's studies.

In northeastern Illinois Swink (1959 and 1965) noted that hairy woodpeckers showed a definite preference for oaks, especially white oak forest.

Considering the relative abundance of its smaller counterpart—the downy—the hairy woodpecker is surprisingly uncommon in Illinois, and the available data indicate that it always has been (Ridgway 1881*a*; Nelson 1876–1877; Du Bois 1918; Cahn & Hyde 1929). On the Illinois River Barnes (1890) found the hairy to be fairly common, but later (Barnes 1912) observed that the species had become rare. He placed the blame for the change on the house sparrow, which, he said, appropriated almost every hairy woodpecker nest in the area and even killed nestlings of the woodpecker (Bent 1939 ascribed this observation to Benjamin Gault). In general, the population measurements for the hairy suggest a continuing decline. Both Barnes (1890) and Ridgway (1887) refer to the nesting of hairy woodpeckers in orchards, a habitat not now used at any significant population level. Even in earlier times, however, hairy woodpeckers were rare in man-dominated habitats, including residential habitat (Ridgway 1887). The only other reference to interspecific aggression is that of Stickel (1963), who described the conflict between a nesting pair of hairy woodpeckers and red-bellies nesting in the same tree.

Hairy woodpecker habitat has not been analyzed precisely. Silloway (unpublished manuscripts 1922 and 1923) repeatedly refers to hairy woodpeckers as being in "large trees" or on "big tree trunks" in contrast to the downy woodpecker. There were no correlations between summer numbers of hairy woodpeckers and any feature or characteristic of the southern Illinois woodlands examined by us in detail (see introduction to this paper). Nor was there any apparent relationship between this woodpecker and other woodpecker species. Such relationships are hard to discern in a species with such low population levels as the hairy woodpecker has at present. The greatest number of hairies in any of these southern woodlands

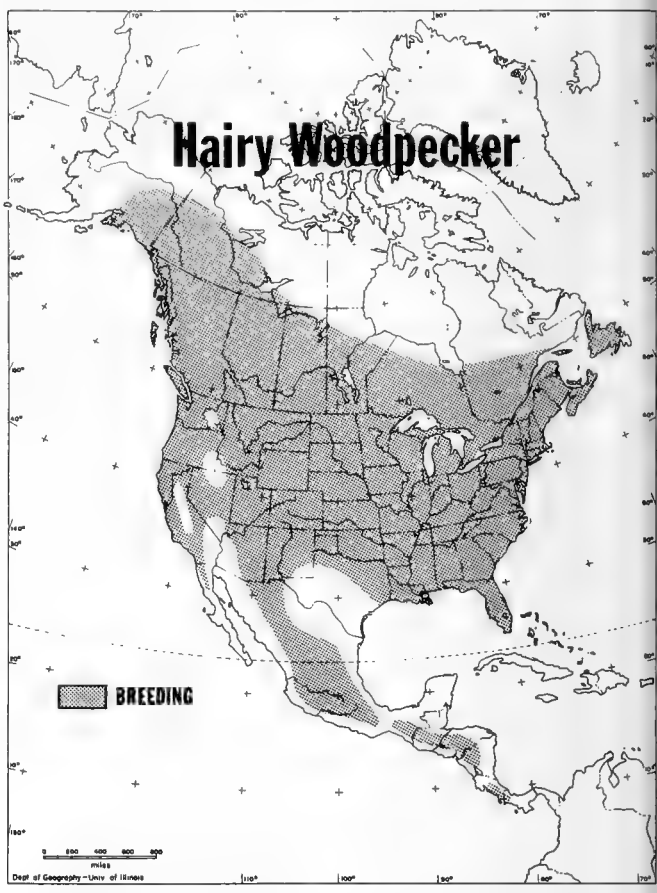

Fig. 39.—General distribution of the hairy woodpecker. The range shown here may include large sections in which populations of the species are thin or even absent because of the nature of the terrain and lack of suitable habitat.

was 5.4 birds per 100 acres in one woodland in 1974 and 5.2 birds per 100 acres in another in 1975. There were over three times as many hairies per acre in the eight bottomland woods as in the five upland woods studied (Table 15).

Hairy woodpecker territories measured in McLean County by Calef (1953*a*) in mature bottomland forest ranged from 1.6 to 3.7 acres, averaging 2.6 acres. Also in central Illinois (Piatt County) Allison (1947) measured one territory—6.5 acres—in mature upland forest. This territory was more than twice the size of downy woodpecker territories (average of four: 2.7 acres) in the same area.

There are site data for only 17 hairy woodpecker nests, mainly in northern and central Illinois. About one-third of the nests were in dead branches of living ashes, elms, and birches; one-third in dead trees or stumps; and one-third in living willows, elms, oaks, and maples. Most of the nests were 15–35 feet high, but one was as low as 5 feet (Hess 1904).

Nesting Cycle

There are only fragmentary data on the nesting cycle of the hairy woodpecker in Illinois. In Central Illinois Fawver (1947*a*) observed hairy woodpeckers

establishing territories about the first week in April, but some courtship behavior begins before then. In northeastern Illinois Gault (unpublished notes 1906, 1907, and 1927) referred to what he called "mating" or "courtship" behavior by hairies in aggregations of four or more birds throughout March. Vocalizations have not been studied in Illinois, but Lawrence (1967) pointed out that the hairy's courtship display involves rather spectacular bounding flights.

Hess (1910) considered the hairy to be the earliest nesting woodpecker in the Philo area. If cavity excavation has been observed in Illinois, the observation has not been published. Hairy woodpecker nest cavities in Illinois have varied from 10 to 15 inches in depth, with entrance holes ranging from 1½ to 2½ inches in diameter (Loucks unpublished notes 1893; Fawver 1947*a*; Calef 1953*a*). One cavity was 4½ inches wide (Chicago Museum of Natural History oology specimen label 16552). Link (1945) stated that the cavity entrance for the hairy woodpecker was 1¾ inches in diameter, and Ford (1939) gave these specifications for a cylindrical nest box for the hairy: floor, 6 inches in diameter; depth, 12–15 inches; entrance above floor, 9–12 inches; and diameter of entrance, 1½ inches, the box to be placed 12–20 feet high. We know of no case of the use of a nest box by the hairy in Illinois.

Like the rest of the cycle, the egg-laying season of the hairy woodpecker is poorly known in Illinois. The eggs are the typical immaculate glossy white of woodpeckers. In central Illinois Hess (1904) referred to a nest with four eggs on 24 April, and there is a Chicago record of a nest with two eggs on 30 April (Anonymous 1877). Most of the "fresh-egg" sets in museum collections and those referred to in the literature were laid in May, especially 1–20 May. However, there are references that indicate much earlier laying. Sanborn (1922*a*) found two nests on the Kankakee River in the period 20–22 May, with young ready to fledge, and R. M. Barnes (Chicago Museum of Natural History oology specimen label 7340) referred to a nest at Lacon with three addled eggs and one young ready to fledge on 8 May. If we assume an incubation period of 11–12 days and a nestling period of 28–30 days

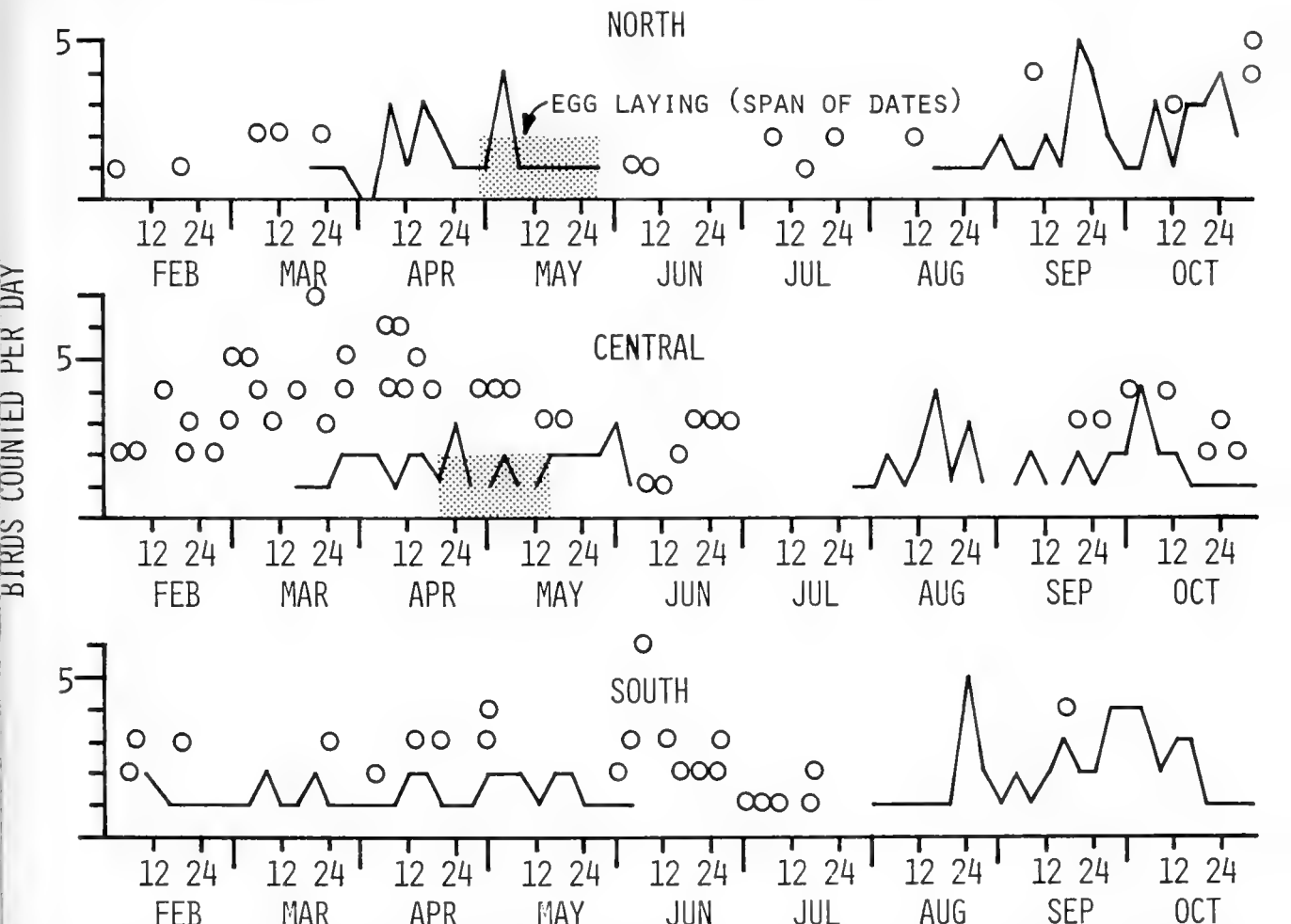

Fig. 40.—Numbers of hairy woodpeckers seen throughout the spring and fall seasons, with the span of egg-laying dates shown by the stippled area. The graph line represents higher count of each 4 days of a continuous record (1967–1970). Hollow circles represent counts from other years or other observers.

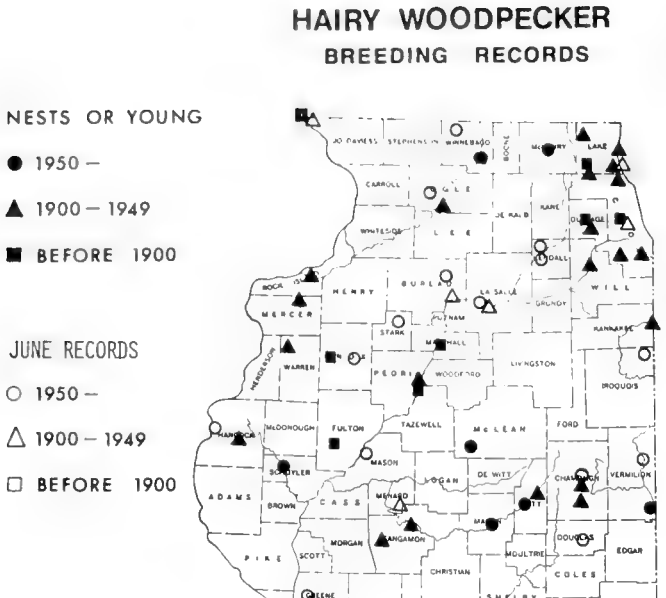

Fig. 41.—Distribution of breeding records of the hairy woodpecker in Illinois. Hollow symbols represent birds seen or heard in June.

(Lawrence 1967), eggs in the Kankakee nest could have been laid as early as 9 April, and those in the Lacon nest might have been laid even in late March depending upon how near the young were to fledging. There are no egg-laying dates for southern Illinois.

We have found clutch data on only 13 Illinois nests with eggs, none in the south. The distribution of clutches was: six eggs, two nests; four eggs, eight nests; and three eggs, three nests. The absence of five egg sets is probably only an accident of the small sample. Hess (1904) pointed out that the incubating adult sits very close and is difficult to dislodge from the eggs.

Most nests have been found with young fairly well grown, as the young are often noisy then and conspicuous.

There are no data on nesting success or productivity.

Fall Populations

The events of late summer and fall among the hairy woodpecker populations of Illinois are particularly obscure. Though no migration is known, there is some movement by at least part of the population to nonforest habitats, including most notably urban residential areas. We first noted a hairy in open country on 13 September in the south.

We have seen hairy woodpeckers in what appeared to be fresh plumage as early as 4 September, and others obviously in heavy molt on 11 September. George (1972) observed that it took about 4 months for juvenile hairies to complete the molt and pointed out that some juveniles may still be aged on the basis of their primaries well into October.

TABLE 15.—Breeding populations of hairy woodpeckers in Illinois.

Habitat	Acres	Birds per 100 Acres[a]	Years	Type of Census	Region or County	Reference
Oak-maple forest	55	0–7 (avg 3.2)	1927–1975	Map	Champaign (C) [b]	Kendeigh 1944
Oak-maple forest	64	9	1943	Map	Champaign (C)	Johnston 1947
Forest (all types, including edge)	214	1–4 (avg 2.8)	1957–1958	Strip	Central	Graber & Graber 1963
Forest (all types, including edge)	340	2–4 (avg 2.6)	1957–1958	Strip	South	Graber & Graber 1963
Forest (unspecified)	20	10	1914–1916	Nest	Rock Island (N)	John J. Schafer (unpublished notes 1914–1923)
Forest (unspecified)	54	4–9 (avg 7.1)	1917–1923	Nest	Rock Island (N)	John J. Schafer (unpublished notes 1914–1923)
Mature upland forest	479	0–1 (avg 0.4)	1974–1975	Strip	South	This paper
Mature bottomland forest	1,077	0–5 (avg 1.3)	1973–1975	Strip	South	This paper
Virgin floodplain forest	77	10	1948	Map	Sangamon (C)	Snyder et al. 1948
Virgin floodplain forest	50	4	1947	Map	Piatt (C)	Fawver 1947*b*
Mature bottomland forest	63	17–24 (avg 20.6)	1950–1951	Map	McLean (C)	Calef 1953*a*
Upland second-growth oak-hickory forest	56	4	1941–1942	Map	Sangamon (C)	Robertson 1941*b*, 1942*b*
Upland oak-hickory forest	24	4	1967	Map	Hancock (C)	Franks & Martin 1967

[a] All figures were converted to birds per 100 acres (territorial males or nests × 2).
[b] C refers to the central region of Illinois and N to the northern, as shown on winter distribution maps, e.g., Fig. 5.

Our daily counts of hairy woodpeckers in the state were higher in fall (August–October, inclusive) than in spring (March–May, inclusive) but only slightly: 1.3 in fall to 1.0 in spring. The ratio was higher in both the north (2.1:1.0) and south (1.5:1.0), but in central Illinois the ratio (1.0 to 1.2) showed a slight decline in fall. The data seem to indicate poor productivity. Banders should make an effort to get age ratios on this species in fall, using the primary character (George 1972).

Winter Populations

The hairy woodpecker is to be expected in every county in winter, and the absence of records for a number of counties is probably only indicative of a shortage of study in those areas (Fig. 42). Hairies are regularly detected on virtually all Christmas counts. Several observers, particularly in northern Illinois, have noted that hairies are conspicuously more common in winter than in summer (Nelson 1876–1877; Eaton 1878; Smith & Beecher 1958). At least a few hairy woodpeckers move to more open habitats in winter, but this is not a major population shift (Table 16). In the south, however, there is a notable shift by hairies to greater use of urban residential habitat and upland forest in winter. In our 1974–1976 censuses in the south, winter population density, on the average, declined slightly from summer levels in bottomland but increased in upland forest.

The winter population densities from the cross-country censuses of 1907 and 1957–1958 indicate a decline of the hairy, at least in southern Illinois, where the largest samples were taken (Table 16). The Christmas counts also show a downward trend since 1900 (Fig. 43). As there were few counts in the south in the early years, the data for that region are the least dependable. On the other hand, the northern and central counts show the same pattern, and their 5-year averages (Fig. 43) are significantly correlated ($r = 0.924$, $P = < 0.001$).

Cooke (1885*b*) called the hairy woodpecker abundant in Union County and reported seeing 10–20 per day. Our highest count during the forest censuses (two observers in one party) was six hairies in 4 hours —also in Union County.

The numbers of hairy woodpeckers in winter show positive correlations with the numbers of large trees per acre (trees over 22 inches DBH) both in upland and bottomland habitats ($r = 0.987$ and 0.910, respectively, $P = < 0.001$). They also show positive correlations with the diversity of genera and species of large trees. For upland woods the correlation between the number of genera of large trees and the number of hairy woodpeckers is 0.953 ($P = < 0.01$) and for the species it is 0.996 ($P = < 0.001$). For bottomland woods the correlation was 0.828 for number of genera of large trees and 0.822 for number of species ($P = < 0.01$). In other words, in winter this woodpecker seems to prefer mature woods with a variety of large trees present.

There may be some competition or conflict between hairy woodpeckers and red-headed woodpeckers. There is a negative correlation between the numbers of these two species ($r = -0.772$, $P = < 0.02$) in bottomland woods. Conversely, the numbers of hairy and red-bellied woodpeckers showed a positive correlation in six of the eight bottomland woods examined ($r = 0.768$, $P = <0.05$).

Food Habits

There are numerous references to hairy woodpeckers at feeders, especially at suet (Childs 1922; Lampert 1922; Patterson 1923; Cone 1956). At a feeder in Ottawa, Bellrose (1934–1935) observed the hairy to be shyer than the downy but dominant over the smaller species in conflicts. At Glen Ellyn, Gault (unpublished notes 1894 and 1914) observed a hairy feeding on poison ivy fruit in October. In Union County in winter

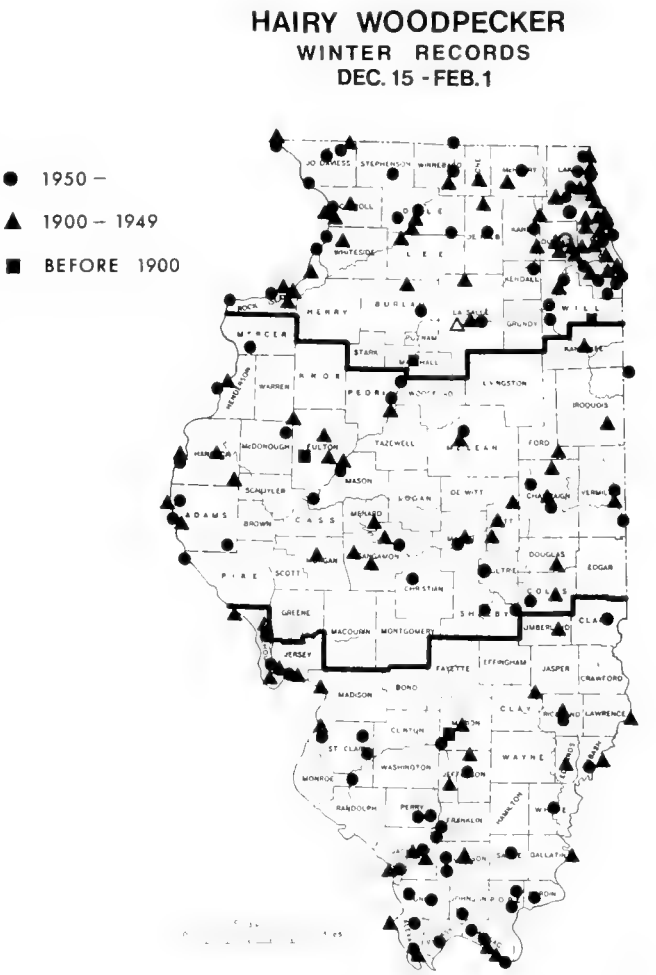

Fig. 42.—Distribution of winter records of the hairy woodpecker in Illinois. The three regions of the state referred to in the text are separated by the two heavy horizontal lines.

TABLE 16.—Winter populations of hairy woodpeckers in Illinois.

Habitat	Acres	Birds per 100 Acres	Years (January)	Type of Census	Region or County	Reference
Urban residential	355	0	1976	Strip	North & Central	This paper
Urban residential	191	1–4 (avg 2.1)	1976	Strip	South	This paper
Suburban woodlot	20	10	1968–1972	Map	Lake (N) [a]	Miller & Miller 1972
Oak-maple forest	55	0–4 (avg 2.5)	1925–1948	Map	Champaign (C)	Kendeigh 1944, 1948*a*
Oak-maple forest	55	2–7 (avg 3.2)	1949–1975	Map	Champaign (C)	Kendeigh et al. 1957; Kendeigh 1973
Forest (all types, including edge)	46	0–2 (avg 1.1)	1940–1941	Map	Piatt (C)	Johnston 1942
Forest (all types, including edge)	65	3	1907	Strip	North	Graber & Graber 1963
Forest (all types, including edge)	45	0	1957–1958	Strip	North	Graber & Graber 1963
Forest (all types, including edge)	50	2	1907	Strip	Central	Graber & Graber 1963
Forest (all types, including edge)	152	3–6 (avg 4.6)	1957–1958	Strip	Central	Graber & Graber 1963
Forest (all types, including edge)	241	3	1907	Strip	South	Graber & Graber 1963
Forest (all types, including edge)	211	0–2 (avg 0.9)	1957–1958	Strip	South	Graber & Graber 1963
Mature upland forest	772	0–3 (avg 0.9)	1974–1976	Strip	South	This paper
Mature bottomland forest	1,398	0–5 (avg 0.9)	1974–1976	Strip	South	This paper
Bottomland forest	50	2–6 (avg 3.0)	1950–1953	Map	Cook (N)	Montague 1950, 1953
Grazed bottomland woods	53	2–4 (avg 2.5)	1955–1957	Map	Macon (C)	Chaniot & Kirby 1955*b*, 1956; Kirby & Chaniot 1957
Shrubby field and forest edge	70–85	(+) [b]	1948, 1955–1956	Map	Richland (S)	Hundley et al. 1956
Shrubby field and forest edge	40	0–2	1960–1965, 1968	Map	Lawrence (S)	Shaw 1961; Axelson et al. 1965

[a] N refers to the northern region of Illinois, C to the central region, and S to the southern, as shown on winter distribution maps, e.g., Fig. 5.
[b] The plus symbol (+) indicates fewer than one bird per 100 acres.

Cooke (1885*b*) noted that hairy woodpeckers damaged corn in fields adjacent to forest, but Beal's (1911) extensive study of stomach specimens from 33 states showed that corn was an insignificant part of the hairy's diet. His study showed the hairy to have one of the most consistent diets through the year, being about 78 percent animal matter and 22 percent vegetable. In June the animal content went as high as 90 percent.

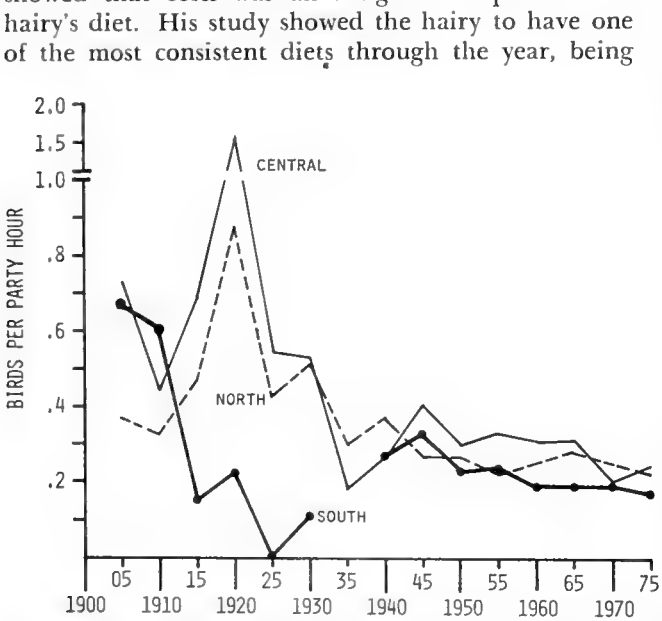

Fig. 43.—Hairy woodpeckers seen per party hour on Audubon Christmas counts in the three regions of the state. Each point represents a 5-year average.

The dominant foods, constituting about 31 percent through the year and reaching as high as 41 percent in December, were the larvae of wood boring beetles, especially Cerambycidae, Buprestidae, and Lucanidae. Some stomachs had large numbers (up to 100) of such larvae. Beal (1911) found ants to be the second most important item in the hairy's diet, constituting about 17 percent (27 percent in January) and, like the borers, present every month. Caterpillars, the third most important food, were also present every month and made up about 10 percent of the food. Webster (1881) and Waldbauer et al. (1970) pointed out the importance of hairy and downy woodpeckers as predators on cecropia cocoons.

Of the vegetable food, Beal (1911) found that about 5 percent of the diet was fruit, mainly wild (sassafras, dogwood, sumac, etc.). About 11 percent was mast, notably beechnuts, hazelnuts, and acorns. Seeds, such as foxtail, vervain, and mustard made up about 4 percent of the diet.

Longevity

Hairy woodpeckers appear to be rather long-lived. Reuss (1963) reported on a hairy woodpecker that

vas banded in Cook County, 9 November 1952, and eturned on 3 November 1963, making it at least 11 ears old—the oldest on record in Illinois. Two other airy woodpeckers (males) banded in northeastern llinois were at least 7 and 8 years old, respectively computer printout from U. S. Fish and Wildlife Serice Bird Banding Office 1972 and 1974). Bartel's 1964 and 1967) oldest banded hairies were just under years. There are no studies of age distribution for ny Illinois population of hairy woodpeckers.

There is but one reference on any mortality factor f the hairy. Brown & Bellrose (1943) found hairy voodpeckers to be 3 of 259 identified prey items of creech owls in southern and central Illinois, probably nainly in winter. Only seven of the prey items were lownies—i.e., about twice the number of hairies. Our vinter counts indicate a ratio of about six downies to ne hairy in the south, which is also the ratio of the wo species in the Christmas counts. The ratio shown n central Illinois Christmas counts was about five lownies to one hairy. These observations imply that creech owls are more likely to catch hairies than ownies.

pecimen Data

There are several references to the occurrence of wo races of hairy woodpeckers in Illinois (Ferry 907*b*; Howell 1910; Ridgway 1914; and others). 'erry (1907*b*) pointed out that specimens from southrn Illinois were small, resembling in that respect the orm *D. villosus audubonii* of the southeastern USA. n color, however, the southern Illinois specimens vere clear white below, as in *D. v. villosus*. All Illiois specimens we have seen have been thus colored nd are probably best referred to the nominate race.

There is a suggestion of size difference between airies from north of the latitude of Pike County and hose from south of Pike County, but presently there re too few specimens available to determine whether ie change is consistent and whether it is merely a mooth cline with latitude.

The wing and tail length ranges and means for x northern and central males (worn, molting, and uvenile specimens excluded) were: wing, 118–124 m (mean: 120.1 mm, SD: 2.23); tail, 74–78 mm nean: 76.5 mm, SD: 1.16); and for five southern nales: wing, 112–118 mm (mean: 115.4 mm, SD: .46); tail, 59–71 mm (mean: 67.5 mm, SD: 4.81). Ieasurements for three northern and central females vere: wing, 116–124 mm (mean: 119.3); tail, 70–77 m (mean: 73.2 mm); and for eight southern fenales: wing, 110–118 mm (mean: 113.6 mm, SD: .44); tail, 63–71 mm (mean: 67.9 mm, SD: 2.75).

We have but four weight records for Illinois hairy voodpecker specimens, one male and three females. Veights of the females, all taken in January–February n southern Illinois, were 58.0, 60.5, and 66.0 grams. male from Union County weighed 68.5 grams in eptember.

DOWNY WOODPECKER
(Dendrocopos pubescens)

(Fig. 44 and 45)

Spring Populations

There is no proof that downy woodpeckers migrate in Illinois, despite some suggestions to the contrary (Woodruff 1907; Anonymous 1916; Swink 1959; Graber & Graber 1963). Cooke's (1888) explanation of the downy's apparent population shifts as more or less local winter wandering to forage is probably the most reasonable. The published banding records for downies in Illinois (Cooke 1937 and 1950; Bartel 1959*a*, 1959*b*, and 1964; Lincoln 1924 and 1927) include no record of a recovery very far distant from the place of banding.

The presence of 10 downy woodpeckers among numerous night migrants killed in Lake Michigan during the disastrous storm on the night of 16 April 1960 (Segal 1960) is not necessarily indicative of migration, as the birds may have been blown from perches along the lake shore.

Despite the absence of migration in this species, the pattern of the daily counts of downy woodpeckers (Fig. 46) has peaks in spring and fall similar to the patterns for migratory species. These peaks probably reflect activity related to changes in habitat and habit from winter foraging to nesting and back, as noted by Cooke (1888), Twomey (1945), and Graber & Graber (1963). Twomey (1945) noted this change about 1 May in east-central Illinois.

Distribution

Downy woodpeckers of one form or another occupy nearly all of North America where there are trees (Fig. 45). In Illinois they are probably to be found in every township though the published record is still very incomplete (Fig. 47).

Nesting Habitats and Populations

With the onset of nesting, downy woodpeckers become primarily forest dwellers, particularly of the forest interior (Kendeigh 1944; Twomey 1945). In central Illinois Hess (1910) and Hankinson (1915) noted that downies were more common in lowland forest than in upland, and our data for southern Illinois forests (Table 17) also show downy populations consistently higher in bottomland than in upland. The highest population densities for downies have been recorded in virgin or old lowland forests (Table 17). Shrub areas have population levels similar to those in upland forests. The woody habitat with lowest populations of downies is urban residential habitat (Table 17). Within the bottomland forests sudied by us in southern Illinois, there was a positive correlation between summer numbers of downies and the percentage of the total basal area

Fig. 44.—Male downy woodpecker. Note the small bill and the bars on the outer rectrices (compare with hairy woodpecker Fig. 38).

of medium sized trees (10–22 inches DBH) ($r = 0.867$, $P = < 0.01$). We found a negative correlation between downy numbers and the percentage of total basal area contributed by large trees ($r = -0.834$, $P = < 0.01$). There was a positive correlation between downy populations and the numbers of dead trees in the southern Illinois woodlands ($r = 0.799$, $P = < 0.01$). This correlation agrees with observations in central Illinois by Williams (1975), who noted extensive use of dead trees in bottomland woods by downies, although downy woodpeckers did not show the great increase in numbers apparent in the red-head population following a massive tree kill from flooding in Calhoun County (Yeager 1955).

In the upland woods studied by us in southern Illinois, we found no correlations between density (number per acre), basal area, and sizes or kinds of woody plants present and downy numbers. There was a correlation between downies and red-bellied woodpeckers ($r = 0.804$, $P =$ ca 0.05), suggesting that these two bird species prefer similar habitat in the uplands.

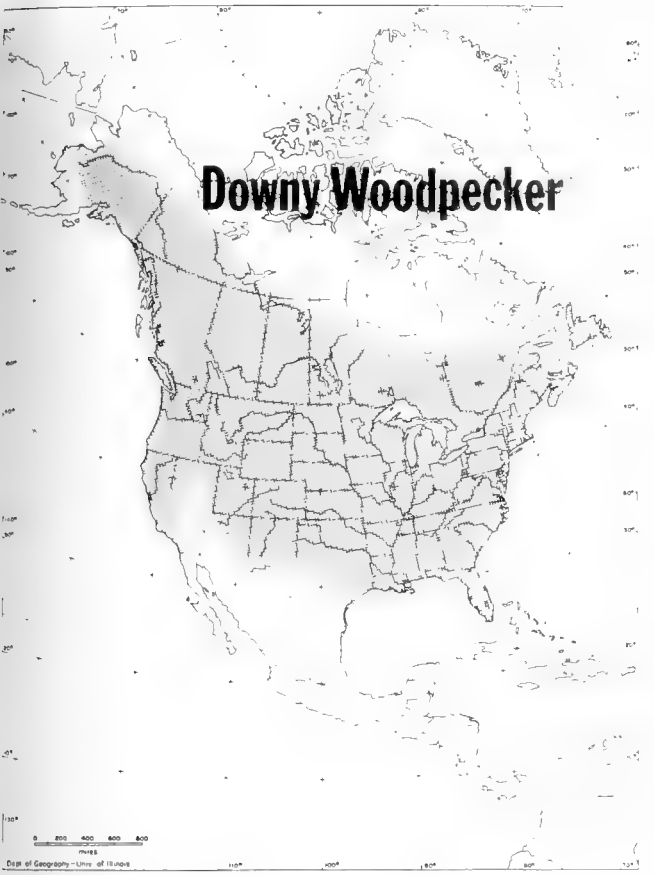

Fig. 45.—General distribution of the downy woodpecker. The range shown here may include large sections in which populations of the species are thin or even absent because of the nature of the terrain and lack of suitable habitat.

In northeastern Illinois Swink (1959 and 1965) found that downies were most often seen in white oaks, bur oaks, elms, willows, and hawthorns. William Starrett (personal communication) found downies particularly common in stands of willow on the Illinois River. The most commonly recorded nest trees of downy woodpeckers have been willows and elms, but the vast majority of nests are in dead trees or dead branches of trees, and a variety of species have been used, including willow, red oak, white oak, plum, silver maple, apple, ash, crabapple, shagbark hickory, sassafras, sycamore, and tree-of-heaven. The heights of 41 nests ranged from 4 to 50 feet and averaged 19 feet.

Our observation that downy populations were notably higher in central Illinois than in either the north or south (Graber & Graber 1963) is puzzling, as population densities within a given habitat do not ordinarily change so abruptly. The observation needs corroboration from studies on larger census areas on forest tracts of comparable quality between regions.

Breeding territories of downies in mature lowland forest measured in central Illinois by Calef (1953*a*) and Fawver (1947*b*) ranged from 1.3 to at least 4.7 acres. Calef (1953*a*) measured nine downy territories in 1950 (range: 1.3–3.1 acres, average: 2.0 acres) and four in 1951 (range: 1.3–2.1 acres, average: 1.5 acres).

Nesting Cycle

Johnston (1944) has described the courtship behavior of the downy woodpecker in central Illinois. At such times the birds are noisy, and their chasing episodes often involve three or more birds together. The increased conspicuousness from this behavior probably accounts, to some extent, for the generally high counts in spring (Fig. 46). Musselman (1937) has noted "drumming" behavior by downies as early as 5 January, but active courtship is not usually observed in central Illinois until late February or March, continuing at least through April. The periodicity of neither calling nor drumming has been studied. Jackson (1919) gave phonetics for the common call note as "pique," which, when repeated rapidly, makes a kind of song (trill). Mating and nest excavation have been observed most often in late April in central and northern Illinois (Ford et al. 1934; Coursen 1947; Fawver 1947*a*; Gault unpublished notes 1910), but observations are lacking for the south. The use of nest boxes by downies has never been recorded in Illinois, and is apparently rare, but Ford (1939) recommends these house dimensions for the species: floor, 4×4 inches; depth of cavity, 8–10 inches; entrance above floor, 6–8 inches; and diameter of entrance, $1\frac{1}{2}$ inches. Calef (1953*a*) measured natural nest cavities of downies in Funks Grove and found them to vary from 2.5 to 4 inches in diameter and from 7 to 10 inches in depth, with entrance holes 1.1–1.5 inches in diameter. Link (1945) notes the nest entrance to be 1.5 inches for downies. The time requirement for cavity construction has not been recorded in Illinois, but Lawrence (1967) recorded the time at eight nests as 13–20 days. No nest other than the cavity is built.

The earliest egg laying by downies, known to us, was 30 March in southern Illinois and more than a month later in the north (Fig. 46). The duration of the laying season is very poorly known but extends to at least 1 June in the north (Fig. 46). The apparent brevity of the laying season probably reflects more the paucity of study than the actual biology of the species. The eggs, typical of those of woodpeckers, are immaculate white. Twenty-two sets of eggs, mainly old (around 1900) museum specimens from northern Illinois, showed this distribution of clutches: six eggs, 5 (23 percent); five eggs, 14 (64 percent); four eggs, 2; three eggs, 1. The incubation period has not been measured in Illinois, but Lawrence (1967) found the period to be 12 days in Ontario.

Young birds have been observed out of the nest in central Illinois as early as 3 June (Fawver 1947*a*)

and in the north by 9 and 10 June (Ford et al. 1934; Sanborn & Goelitz 1915). By mid-June groups of wandering young and adults are common in central Illinois (Weise 1951). The length of nestling life, 20–22 days, is relatively short for a woodpecker, and the duration of parental care extends at least 3 weel beyond fledging (Lawrence 1967).

Nesting success has never been measured for ar Illinois population of downies. Strangely (for a cavi nester) there is no reference in the Illinois literatu

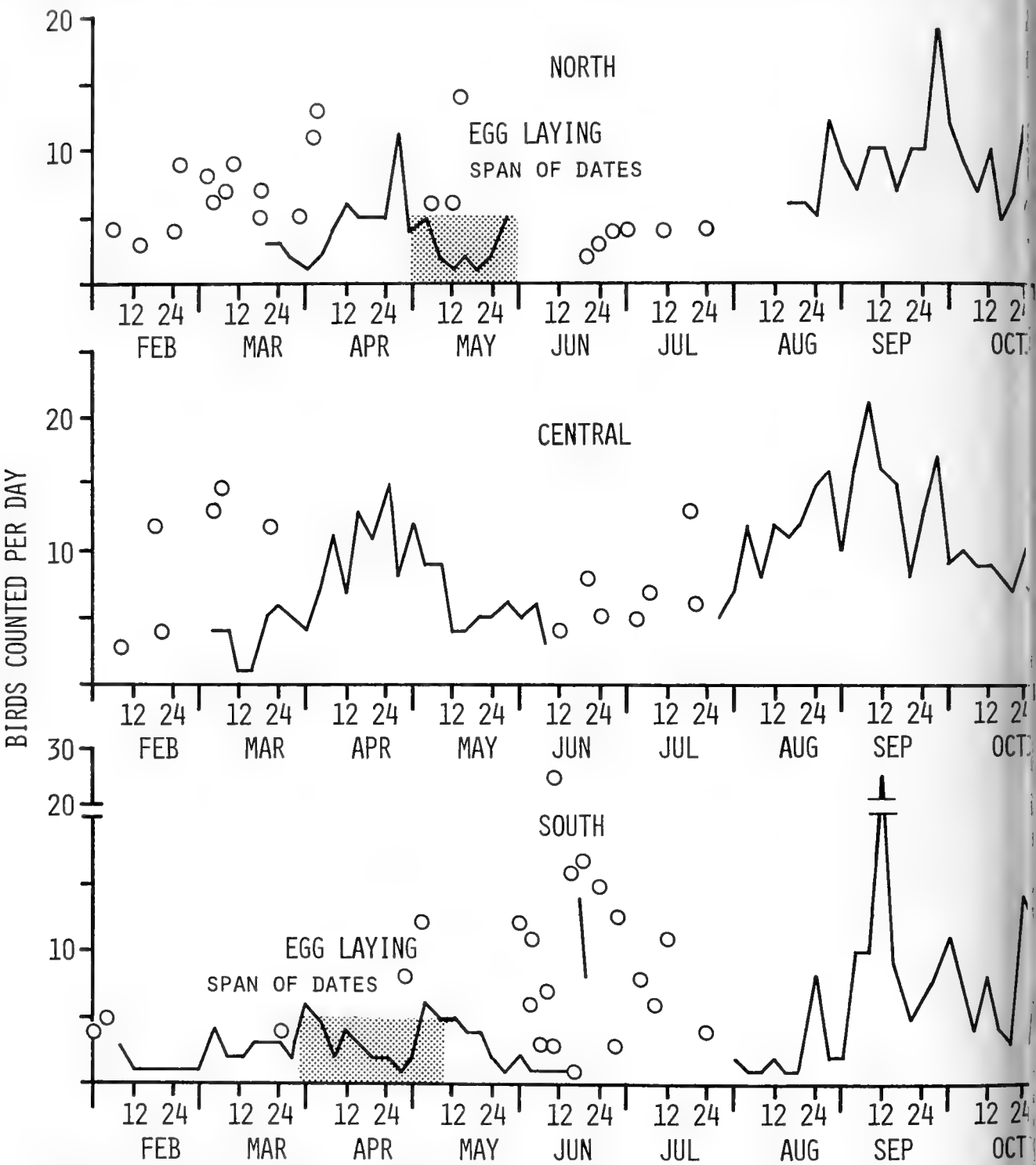

Fig. 46.—Egg-laying season (shaded area) and numbers of downy woodpeckers seen in spring, summer, and fall in the three re gions of Illinois. The graph line represents the higher count of each 4 days during spring and fall from a continuous daily recor made in 1967 and 1970 in southern Illinois, in 1969 in central Illinois, and in 1968 in northern Illinois. Hollow circles show num bers seen in other years or by other observers.

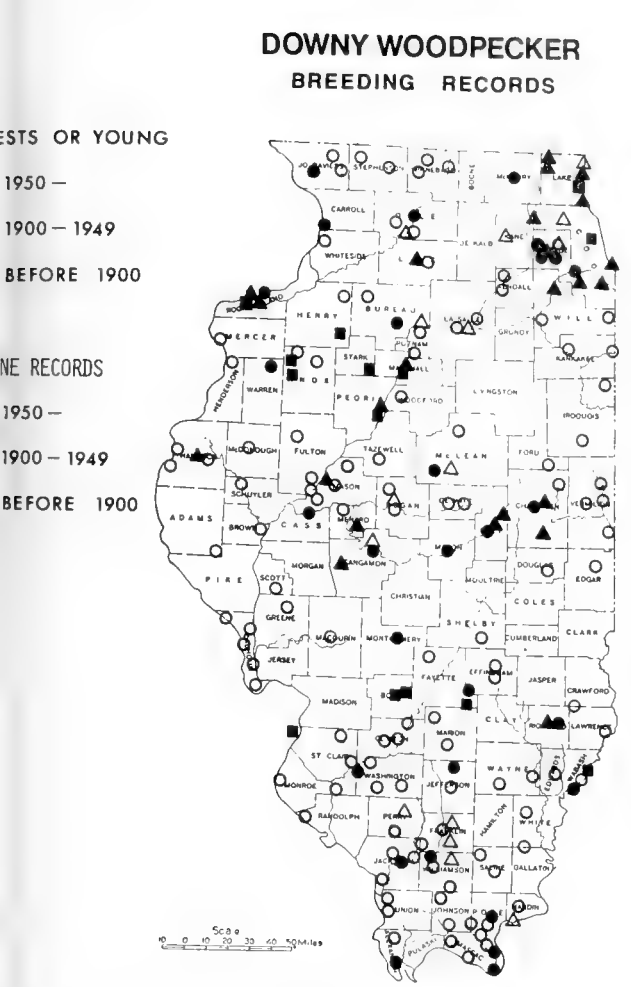

Fig. 47.—Distribution of breeding records of the downy oodpecker in Illinois. Hollow symbols represent birds seen heard in June.

nest competition between downies and other spe-es though downies have been seen attacking wrens Childs 1923).

ll Populations

In late summer downy woodpeckers become quiet d inconspicuous for a time, probably coincidental th the molt. In northern Illinois we have seen wnies about half through the molt in mid-August d early September. George (1972) indicated that e molting period extends into October.

Hulsberg's (1917–1918) statement that downies ere coming into town by 1 September is the only servation on the timing of the post-breeding hab-t changes of the species. Actually their dispersal obably begins in July and August but may not be parent in urban areas until later. This dispersal akes the birds more conspicuous, increasing the ily counts (Fig. 46). Our highest counts of downies me consistently in September, as did also those of ink (1959).

Our spring (March–May) and fall (August–ctober) counts showed a statewide ratio of 1.0 downy woodpecker in spring to 1.9 in fall, the ratio being highest in the north (1.0:2.1) and lowest in the south (1.0:1.7).

Winter Populations

Downy woodpeckers probably occur in every township in the state in winter, but published records are still lacking for a number of counties (Fig. 48). From population densities we conclude that favorite winter habitats are bottomland forest and shrub habitat, but even corn stubble fields have a fairly consistent, though thin, winter population of downies (Table 18). The downy population in urban areas increases notably in winter over summer levels.

Bottomland woods are an important part of the winter habitat of downy woodpeckers in southern Illinois; over two times as many were found in bottomland as in upland woods. There was a correlation between downy numbers and the Importance of *Ulmus* ($r = 0.613$, $P = < 0.10$). There was a similar degree of correlation for large-tree basal area. The converse was also true—a negative correlation between downies and the basal area of small ($r = -0.638$, $P = < 0.10$) and medium-sized trees ($r = -0.665$, $P = 0.05$). These data indicate an ecological difference between winter and summer downy habitat within the same woodlands, since in summer the correlations were reversed.

In uplands downies seem to choose woodlands with ash trees present ($r = 0.969$, $P = < 0.01$) and to avoid, or at least occur in lesser numbers in, woods with oaks ($r = -0.851$, $P = < 0.05$) or hickories ($r = -0.960$, $P = < 0.01$). This indicates a preference for a more mesic upland forest. There was also a correlation ($r = 0.985$, $P = < 0.001$) between downy numbers and upland forests with high percentages of the basal areas made up of large trees, just as in the bottomlands. There were negative correlations for high basal-area ratios of small and medium-sized trees ($r = -0.872$, $P = < 0.05$; $r = -0.979$, $P = < 0.001$, respectively). There was a correlation between downies and the number of large trees (over 28 inches DBH) per acre in upland woods ($r = 0.942$, $P = < 0.01$). In upland woods there was a positive correlation between the downy and the red-bellied woodpecker ($r = 0.973$, $P = < 0.001$). The diet of these two birds indicates little or no competition between them for food in winter.

From the regional variation in downy woodpecker winter populations, based on the statewide censuses (Graber & Graber 1963), we concluded that there was at least one migratory population of downies in the state. There is still no proof based on the recovery of banded birds that such a migration exists. For the entire state the ratio of summer to winter downy woodpecker numbers was 1.0 (summer) to 1.8 (winter), a slight decline from the fall ratio. Because the fall ratios were roughly similar in all regions of the state, we would expect, lacking migration, that the

TABLE 17.—Breeding populations of downy woodpeckers in Illinois.

Habitat	Acres	Birds per 100 Acres[a]	Years	Type of Census	Region or County	Reference
Urban residential	160	1	1958	Strip	North	Graber & Graber 1963
Urban residential	173	0	1958	Strip	Central & South	Graber & Graber 1963
Unmodified woodland	27	7	1937	Nest	Lake (N)[b]	Beecher 1942
Oak-maple forest	55	4–22 (avg 13.5)	1927–1943	Map	Champaign (C)	Kendeigh 1944
Oak-maple forest and edge	55	4–48 (avg 16.7)	1944–1975	Map	Champaign (C)	Kendeigh & Forsyth 1959; Kendeigh & Barnett 1967
Oak-maple forest	64	16	1943	Map	Champaign (C)	Johnston 1947
Forest (all types, including edge)	177	2–5 (avg 3.4)	1957–1958	Strip	North	Graber & Graber 1963
Forest (all types, including edge)	214	11–13 (avg 12.1)	1957–1958	Strip	Central	Graber & Graber 1963
Forest (all types, including edge)	60	5–15 (avg 8.3)	1907, 1909	Strip	South	Graber & Graber 1963
Forest (all types, including edge)	340	3–4 (avg 3.5)	1957–1958	Strip	South	Graber & Graber 1963
Mature upland forest	479	1–8 (avg 3.1)	1974–1975	Strip	South	This paper
Mature bottomland forest	1,077	3–26 (avg 9.2)	1973–1975	Strip	South	This paper
Mature bottomland forest	63	16–30 (avg 23.0)	1950–1951	Map	McLean (C)	Calef 1953*a*
Virgin floodplain forest	77	36	1948	Map	Sangamon (C)	Snyder et al. 1948
Virgin floodplain forest	50	20	1947	Map	Piatt (C)	Fawver 1947*b*
Grazed bottomland woods	53	19	1955	Map	Macon (C)	Chaniot & Kirby 1955*b*
Woods, unspecified	20	10–20 (avg 16.7)	1914–1916	Nest	Rock Island (N)	John J. Schafer (unpublished notes 1914–1923)
Woods, unspecified	54	7–11 (avg 8.1)	1917–1923	Nest	Rock Island (N)	John J. Schafer (unpublished notes 1919–1923)
Second-growth hardwoods	15	13–27 (avg 19.9)	1937–1938	Map	Rock Island (N)	Fawks 1937, 1938
Upland second-growth oak-hickory forest	56	4–11 (avg 7.1)	1941–1942, 1944	Map	Sangamon (C)	Robertson 1941*b*, 1942*b*, 1944*b*
Upland second-growth oak-hickory forest	46	13	1948	Map	Sangamon (C)	Robertson & Snyder 1948
Upland oak-hickory	24	8	1967	Map	Hancock (C)	Franks & Martin 1967
Scrub oak-hickory	40	4	1968	Map	Mason (C)	Johnson 1970
Late shrub	21	18	1966	Map	Vermilion (C)	Karr 1968
Shrubby field and forest edge	60	2	1949	Map	Richland (S)	Stine 1949
Shrub areas	39	5	1909	Strip	South	Graber & Graber 1963
Shrub areas	129	2–3 (avg 2.3)	1957–1958	Strip	South	Graber & Graber 1963
Swamp and thicket	13	2	1950	Map	Jackson (S)	Brewer & Hardy 1950
Swampy prairie	64–67	3	1941–1942, 1944	Map	Sangamon (C)	Robertson 1941*a*, 1942*a*, 1944*a*

[a] All figures were converted to birds per 100 acres (territorial males or nests × 2).
[b] N refers to the northern region of Illinois, C to the central, and S to the southern region, as shown on winter distribution maps, e.g., Fig. 5.

winter ratios would also be similar in all regions. However, data from the cross-country censuses indicated that although the winter populations of downies were far above the summer populations in northern and southern Illinois, the population actually declined in winter in central Illinois. A similar pattern is shown in the population data for Trelease Woods (Kendeigh and others 1941–1975) where the long-term average for the downy population is lower in winter than in summer. The resolution of this paradox would seem to require a large-scale banding of downies, especially in central Illinois.

In the past 10 years (1965–1975) the range of annual variation in the Christmas counts of downies was 7–66 percent (average: 28.8) in the north, 2–38 percent (average: 18.2) in central Illinois, and 3–82 percent (average: 29.2) in the south. Aside from very high peaks between 1915 and 1925 (Fig. 49), the counts show no trend, especially since 1930. The counts indicate little difference in population density between the three regions of the state, agreeing in this respect with other types of census data (Table 18). On average, a party of observers found one downy about every 45 minutes in central Illinois, every 49 minutes in southern Illinois, and one per 60 minutes in the north.

Food Habits

Zimmer (1921) called the downy woodpecker "a suet gourmand," and most of the published references

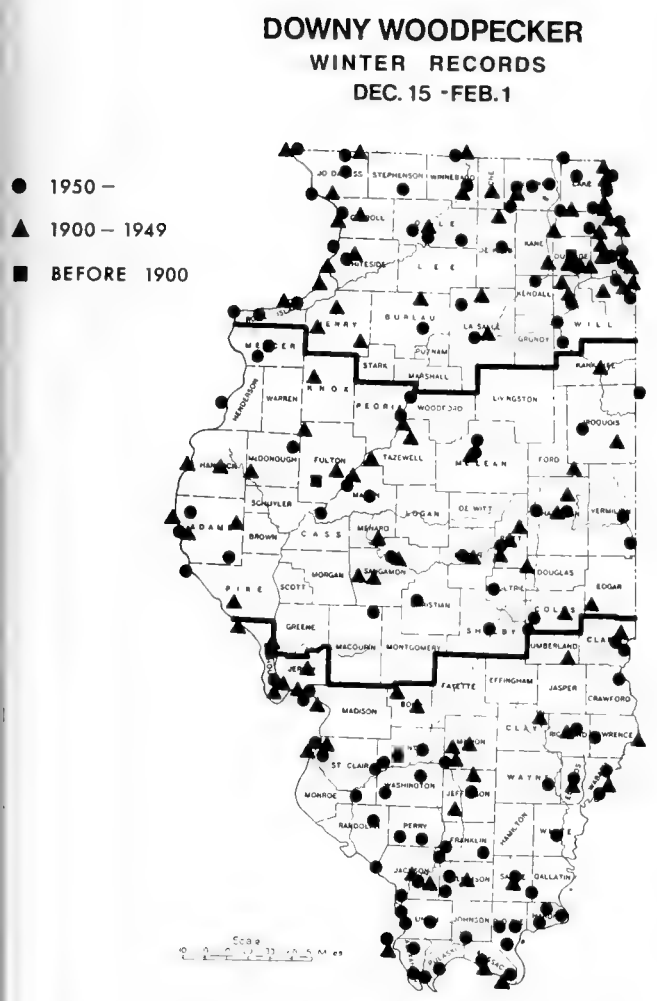

Fig. 48.—Distribution of winter records of the downy woodpecker in Illinois. Heavy horizontal lines separate the three regions (north, central, and south) of the state referred to in the text.

on the food of the downy in Illinois concern its attraction to suet, especially in winter but also at other seasons (Brintnall (1918; Schafer 1918; Cone 1956).

The consistent winter population of downies in fields of corn stubble probably reflects the species' predation on corn borers (Moseley 1947; Wall & Whitcomb 1964). Downies also commonly forage on stalks of giant ragweed, *Ambrosia trifida,* (Adcock 1922; Fawver 1947*a*), but the food item in this case has not been identified. Downies are important predators on the cocoons of cecropia and other Saturniid moths (Waldbauer et al. 1970).

Rice (1946) found the dominant component of the diet of downies in a Champaign County woods to be beetles and their larvae, which comprise 90 percent of the diet in fall, 80 percent in winter, 70 percent in spring, and 50 percent in summer.

Beal's (1911) extensive study included some Illinois specimens. He found that animal matter, mainly insects, made up about 76 percent of the diet, and vegetable matter about 24 percent in the course of a year. Beetles, especially wood-boring cerambycids and buprestids, were the most common food. Ants and caterpillars were also important. A rather surprising dominant food in March specimens from Illinois was grasshopper eggs.

Of the vegetable food, Beal (1911) observed that wild fruits made up about 6 percent of the total, and mast (acorns, beechnuts, etc.) was also important. Some corn was eaten, probably in the form of waste grain. Conspicuous in the diet was the fruit of poison ivy, which germinates freely after passing through the bird, and downies may play a role in spreading this plant.

A measure of the downy's adaptability in foraging is indicated in Southern's (1966) observations of downies feeding on dead gizzard shad in winter and early spring in northwestern Illinois.

Specimen Data

Though two races, *Dendrocopos pubescens medianus* and *D. p. pubescens,* have been ascribed to Illinois (Ridgway 1914; American Ornithologists' Union 1957), we have found no evidence of such geographic variation among the 63 specimens (41 males, 22 females) from Illinois that we have examined. All specimens fell within the probable limits of variation of *medianus.* There was great individual variation in coloration and pattern among downies in contrast to hairy woodpeckers. Tail barring ranged from none (as in *D. villosus*) to heavy, even among specimens from just one county (Will) though specimens with

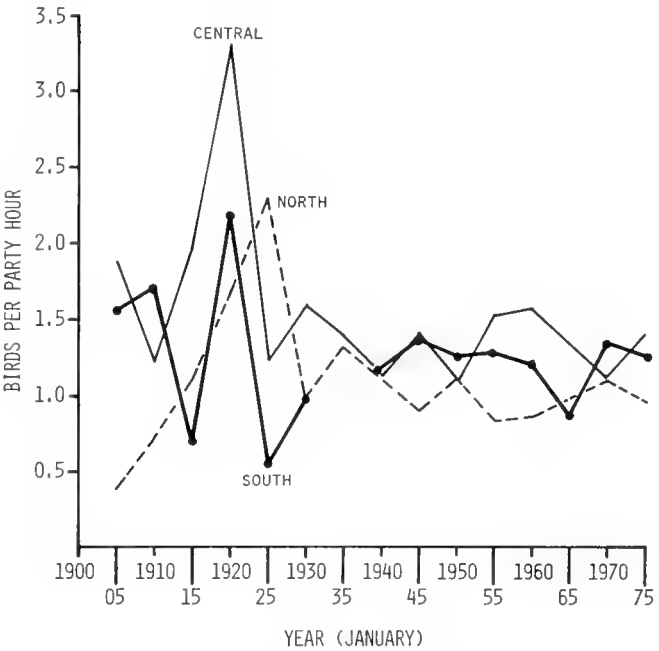

Fig. 49.—Downy woodpeckers seen per party hour on Audubon Christmas counts in the three regions of Illinois. Each point represents a 5-year average.

TABLE 18.—Winter populations of downy woodpeckers in various Illinois habitats.

Habitat	Acres	Birds per 100 Acres	Years (January)	Type of Census	Region or County	Reference
Urban residential	164	0.6	1976	Strip	North	This paper
Urban residential	191	2.6	1976	Strip	Central	This paper
Urban residential	191	3.7	1976	Strip	South	This paper
Suburban woodlot	20	10–15 (avg 12.0)	1968–1972	Map	Lake (N) [a]	Miller & Miller 1968, 1972
Urban park	22	0–5	1960–1962	Map	Cook (N)	Greene 1960; Greene & Greene 1962
Forest (all types, including edge)	46	9–11 (avg 9.8)	1940–1941	Map	Piatt (C)	Johnston 1942
Forest (all types, including edge)	65	9	1907	Strip	North	Graber & Graber 1963
Forest (all types, including edge)	45	4–10 (avg 6.7)	1957–1958	Strip	North	Graber & Graber 1963
Forest (all types, including edge)	50	2	1907	Strip	Central	Graber & Graber 1963
Forest (all types, including edge)	152	1–7 (avg 4.6)	1957–1958	Strip	Central	Graber & Graber 1963
Forest (all types, including edge)	241	3	1907	Strip	South	Graber & Graber 1963
Forest (all types, including edge)	211	7–11 (avg 9.0)	1957–1958	Strip	South	Graber & Graber 1963
Oak-maple forest and edge	55	4–35 (avg 12.8)	1944–1975	Map	Champaign (C)	Kendeigh et al. 1957; Kendeigh & Brooks 1964*a*
Bottomland elm-maple forest	50	12–24 (avg 18.5)	1950–1953	Map	Cook (N)	Montague 1950, 1952
Grazed bottomland forest	53	13–19 (avg 16.3)	1955, 1957	Map	Macon (C)	Chaniot & Kirby 1955*a*; Kirby & Chaniot 1957
Mature bottomland forest	1,398	0–35 (avg 13.7)	1974–1976	Strip	South	This paper
Mature upland forest	772	0–17 (avg 5.6)	1974–1976	Strip	South	This paper
Shrub areas (all types, including edge)	18	11	1907	Strip	North	Graber & Graber 1963
Shrub areas (all types, including edge)	74	6–15 (avg 10.8)	1957–1958	Strip	Central	Graber & Graber 1963
Shrub areas (all types, including edge)	33	3	1907	Strip	South	Graber & Graber 1963
Shrub areas (all types, including edge)	101	5–13 (avg 9.9)	1957–1958	Strip	South	Graber & Graber 1963
Shrubby field and forest edge	70	4	1948	Map	Richland (S)	Stine & Scherer 1948
Shrubby field and forest edge	85	4	1955–1956	Map	Richland (S)	Shaw & Stine 1955; Shaw et al. 1956
Shrubby field	40	(+) [b]–7 (avg 4.4)	1958–1965, 1968	Map	Lawrence (S)	Scherer & Shaw 1960; Shaw 1964
Corn stalks and stubble	602	(+)	1907	Strip	North	Graber & Graber 1963
Corn stalks and stubble	308	2	1957	Strip	North	Graber & Graber 1963
Corn stalks and stubble	360	0	1907	Strip	Central	Graber & Graber 1963
Corn stalks and stubble	759	(+)–1 (avg 0.5)	1957–1958	Strip	Central	Graber & Graber 1963
Corn stalks and stubble	282	1–5 (avg 2.1)	1907	Strip	South	Graber & Graber 1963
Corn stalks and stubble	277	0–1 (avg 0.4)	1957–1958	Strip	South	Graber & Graber 1963

[a] N refers to the northern region of Illinois, C to the central region, and S to the southern, as shown on winter distribution maps, e.g., Fig. 5.
[b] The plus symbol (+) indicates fewer than one bird per 100 acres.

TABLE 19.—Measurements of Illinois specimens of downy woodpeckers, excluding obviously worn, molting, and juvenile specimens.

Region of Illinois	Months	Number of Specimens	Sex	Wing (Chord) in mm			Tail Length in mm		
				Range	Mean	SD	Range	Mean	SD
North and Central	Mar.–May	3	M	90–93	91.1	. . .	54–56	55.1	. . .
North and Central	Sep.–Nov.	7	M	89–94	92.0	1.79	54–58	56.2	0.93
North and Central	Dec.–Feb.	8	M	90–98	93.1	2.45	54–58	56.0	1.72
North and Central	Sep.–May	18	M	89–98	92.3	2.09	51–58	55.9	1.34
South	Feb.–Apr.	10	M	89–95	91.8	1.93	51–58	55.3	2.19
North and Central	Sep.–Mar.	9	F	92–95	93.8	1.25	57–61	58.3	1.17
South	Oct.–Mar.	5	F	93–96	94.0	1.47	55–60	57.5	2.04

immaculate rectrices must be rare. Ventral coloration varied from nearly clear white to strong buffy gray, but not in any consistent geographic pattern.

There was no significant difference in size between downies from northern and southern Illinois or between specimens collected in winter, spring, and fall (Table 19). Again, this lack of differences is in contrast to the differences found in the hairy. Female downies, on average, were slightly larger than males, most notably in tail length.

We have weight data on only five specimens, all males. February specimens weighed 24.3 (Menard County), 28.5 (Jersey County), and 29.7 grams (Pope County). A September specimen from Pope County weighed 26.5 grams, and a November specimen from Brown County, 26.5 grams.

Fig. 50.—Black-backed three-toed woodpecker.

BLACK-BACKED THREE-TOED WOODPECKER *(Picoides arcticus)*

(Fig. 50 and 51)

This northern woodpecker is an uncommon winter visitant of irregular occurrence in northern (particularly northeastern) and central Illinois (Fig. 52). The first record for Illinois was in 1876, when one was found on a telegraph pole in Chicago (Cory 1909).

The black-backed three-toed woodpecker has most often appeared in October and departed in April in the years in which it has been reported; however, the species has been seen as early as 12 September (Redfield 1913) and as late as 19 May (Nolan 1957*b*) in Illinois. The numbers reported each year in Illinois since 1900 are shown in Fig. 53. There are but two records before that time, one in 1876 and another in 1894 (Sanborn 1922*b*). The greatest numbers ever reported for the state were in 1920, reported to have been unusually warm in October and to have had a very mild winter (Eifrig 1921 and 1922). On the other hand, two were reported in Peoria after a severe sleet storm (Starrett 1936).

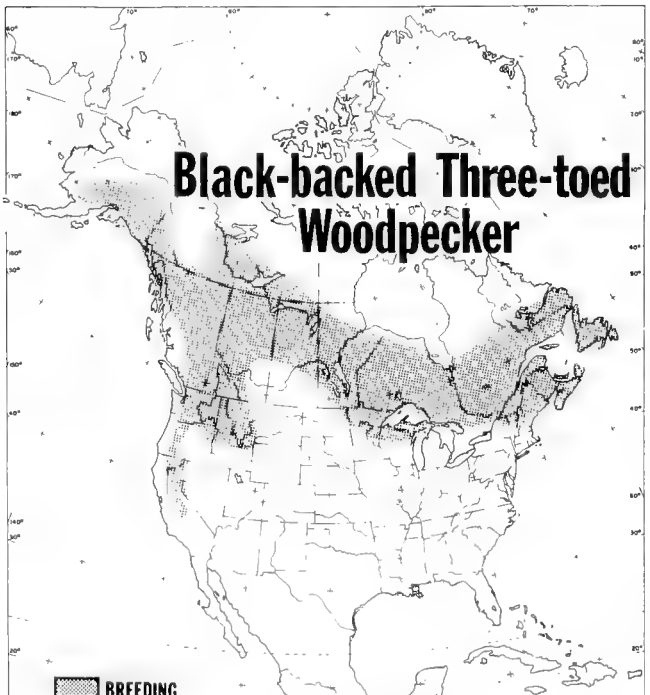

Fig. 51.—General distribution of the black-backed three-toed woodpecker. The range shown here may include large sections in which populations of the species are thin or even absent because of the nature of the terrain and lack of suitable habitat.

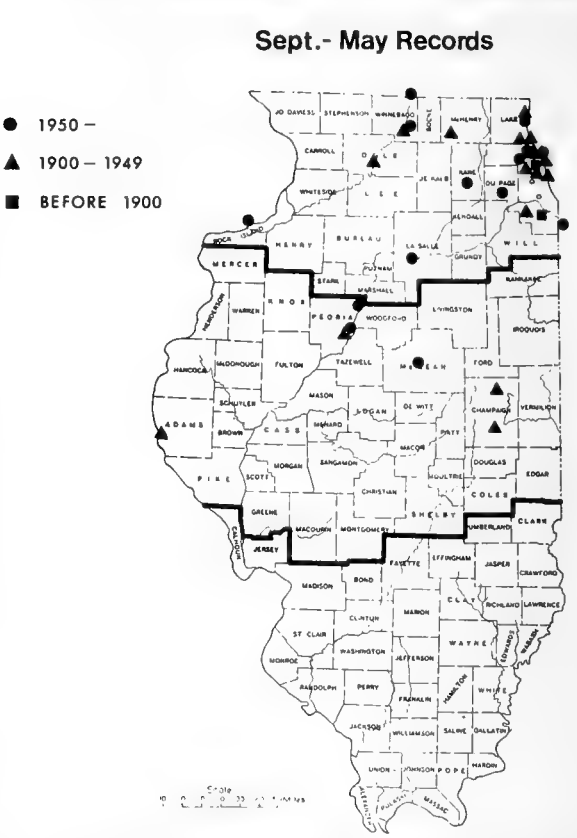

Fig. 52.—Distribution of records of the black-backed three-toed woodpecker in Illinois. Heavy horizontal lines separate the three regions of the state.

Little has been written of the habits of this bird in Illinois. It is usually found singly or, less often, with another black-back. It appears to be unwary, often allowing observers to approach it closely. It frequently has remained in the same area for some days. It is said to be partial to pines and tamaracks (Stoddard 1920). Stoddard also noted that the black-back had a loud and startling call, a rapidly repeated "teck, teck, teck." Redfield (1913) observed that the pecking of the black-back was audible and distinctive. Lewis (1925) and Stoddard (1920) remarked that the workings of this species on trees were characteristic and could be used to detect its presence. Apparently the bird scales the bark from trees and chisels and bores in quite a distinctive way. There are no data on the food of this species in Illinois, but one was observed at a suet feeder (Mumford 1960). Beal (1911) looked at stomachs from 28 specimens outside of Illinois and found that about 89 percent of the food was animal matter and 11 percent, vegetable matter. Most (64 percent) of the food consisted of wood-boring beetle larvae, and wood-boring caterpillars made up about 13 percent. Beal commented upon the large numbers of destructive grubs that these birds must destroy in a year's time.

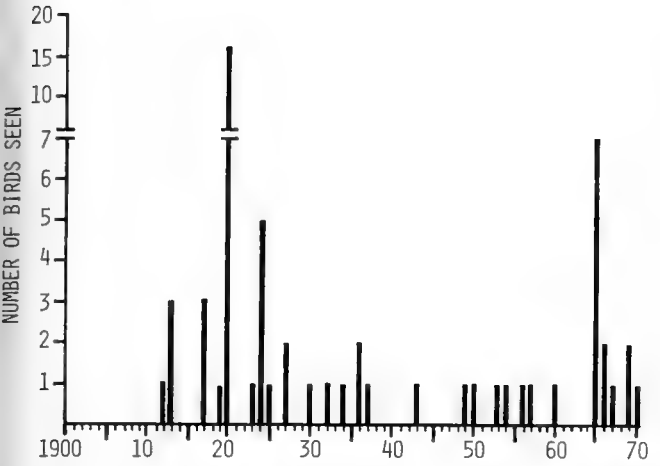

Fig. 53.—Numbers of black-backed three-toed woodpeckers seen yearly in Illinois, with years referring to the beginning of the invasion, e.g., 1920 refers to the winter of 1920–1921. No black-backed three-toed woodpeckers have been reported in Illinois since 1970; however, one was found in Bettendorf, Iowa, in 1975 (Fredricksen 1976).

IVORY-BILLED WOODPECKER *(Campephilus principalis)*

There are but three old records and two records of subfossil remains of this species for the state of Illinois. Audubon (1831) saw the ivory-billed woodpecker near the confluence of the Ohio and Mississippi rivers around 1825, and Ridgway thought that he observed it in White County some 40 miles south of Mt. Carmel circa 1852 (Ridgway 1889 and 1914; Tanner 1942). What may have been the last record for the ivory-bill in Illinois is found in the notes of Benjamin T. Gault, who thought that he heard this bird in swamps near Ullin (Pulaski County) on 15 November 1900 (Gault 1922 and unpublished notes). Ridgway (1874*a* and 1874*b*) thought that the ivory-bill was rare among breeding birds in the lower Wabash Valley, and though he spent time in virgin bottomland timber in that area (Ridgway 1872), he made no mention of any contact with the species at that time.

The habitat of the ivory-billed woodpecker and its habits were described by Tanner (1942), who studied the species in Louisiana. The primary habitat of this bird, according to Tanner, was virgin or mature oak-gum bottomland forest, but it also occupied cypress-tupelo forests. The most important trees (to the ivory-bill) in its habitat were sweet gum, bottomland red oak *(Quercus nuttallii)*, green ash, American elm, pecan, "hackberry" *(Celtis laevigata)*, and overcup oak. All of these trees or closely related counterparts are found in low-lying forests in southern Illinois, where remnants of mature oak-gum and cypress-tupelo forests remain even now. It is thus easy to believe the records of Audubon, Ridgway, and Gault. These sight records are further reinforced by a specimen from Forest Park, St. Louis, Missouri. This bird, a female, number 27343, was collected on 8 May 1886, and according to Hahn (1963), is in the Colorado Museum of Natural History in Denver.

Subfossil remains were found at Cahokia (near Collinsville, Madison County) and near Milan (Rock Island County) (Parmalee 1967). The tarsometatarsus found in a midden at Cahokia suggests that this bird existed in this area 1000–1200 AD, especially since the presence of suitable habitat existing there at that time is indicated by the discovery of a large trunk section of bald cypress at this site (Parmalee 1968). The mandibles found in a historic Sauk-Fox cemetery near Milan are thought to have been used as personal decoration and may have been obtained from other localities by trade (Parmalee 1964).

This large bird required a large area (one pair per 10 square miles) and a lot of large old trees to supply it with an ample food supply of borers and bark beetles. The ivory-bill disappeared as virgin and mature forests were cut. A portion of its habitat was even destroyed on the Singer tract, a wildlife sanctuary maintained by Louisiana at the time the timber was felled. Tanner's observation that greater numbers of woodpeckers, such as the pileated and red-bellied woodpeckers, occurred in the mature forests also occupied by the ivory-bill suggests that we must take care to preserve older woodlands. The continued clearing of bottomland forests for agricultural use and the harvesting practices on forest land may eventually endanger our largest woodpecker now extant, the pileated.

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